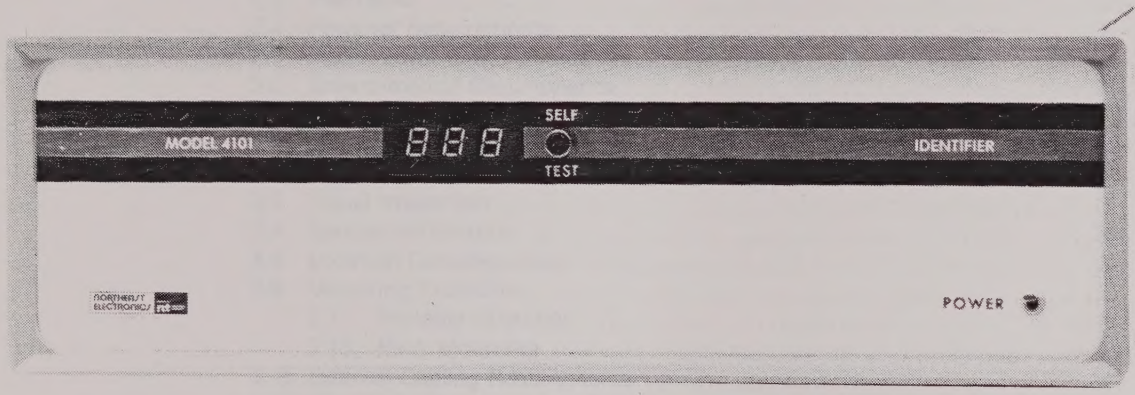
Northeast Model 4101
identifier



NORTHEAST ELECTRONICS
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INSTRUCTION MANUAL

MODEL 4101
IDENTIFIER

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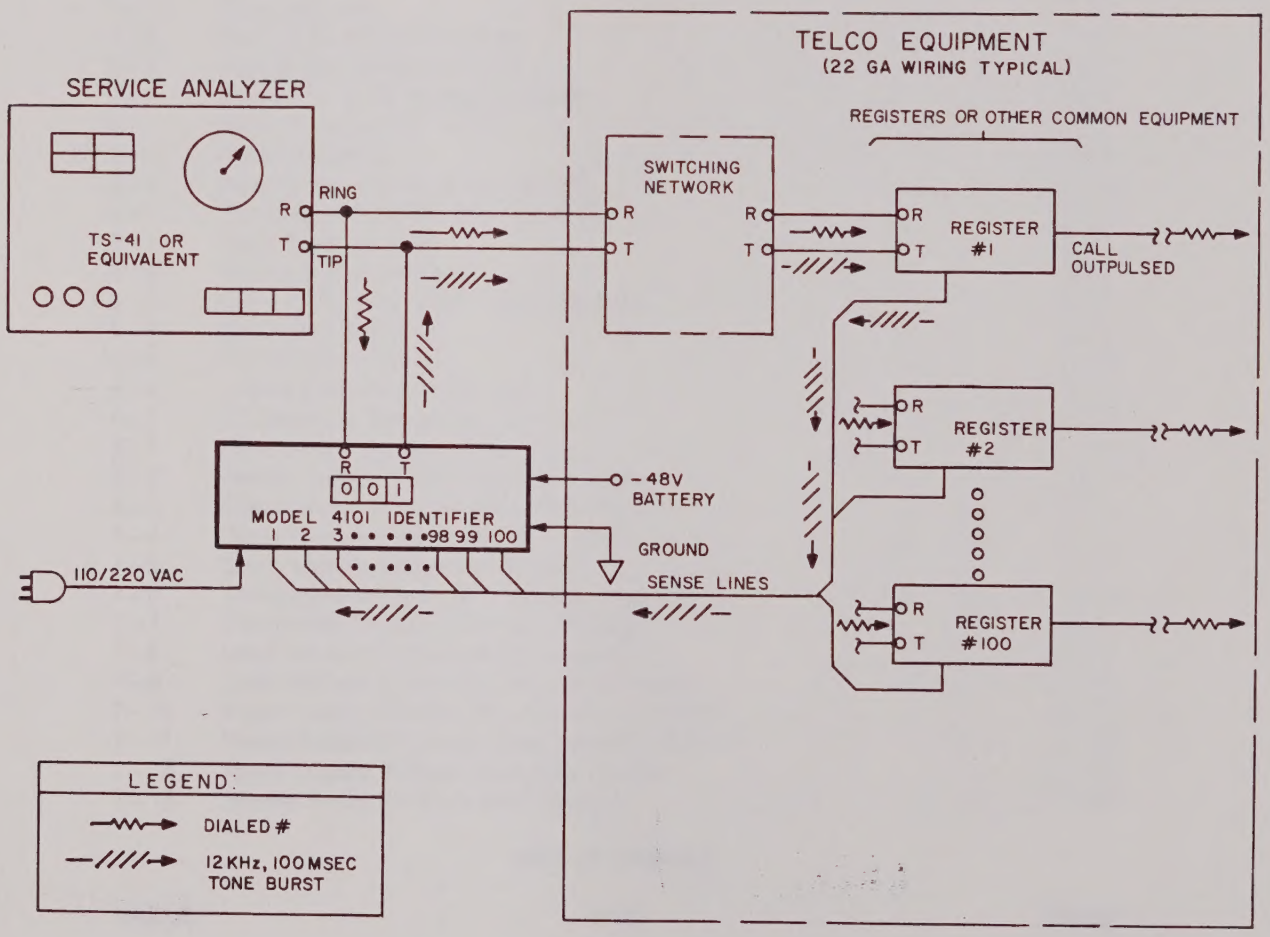


Figure 1—1. Typical Application

SECTION 1

GENERAL DESCRIPTION

1.1 This manual provides operating and maintenance instructions for the Model 4101 Identifier, Northeast Electronics part number A4101-00-900.

1.2 APPLICATIONS

1.3 The Model 4101 can be used to identify any point in a telephone office switch train which has a dc path to the signaling source during the dialing portion of a call. That is, the Model 4101 automatically recognizes and displays the identities of the specific telephone equipment components actually used in servicing individual calls through common control offices. By identifying such components, the Model 4101 simplifies the diagnosis of call completion failures within an office and pinpoints failures to specific equipment units.

1.4 Automatic identification by the Model 4101 is particularly helpful when completion problems exist in office components which are not used for the full duration of a call, for example:

- Registers;
- Register Senders/Receivers;
- Directors;
- Touch Tone® -to-Dial Pulse Converters;
- Similar, shared items which participate in each call only "on demand"

Troubles in such items are often difficult to detect and locate by normal signal tracing techniques.

1.5 The Model 4101 Identifier is used during troubleshooting in conjunction with any two-wire Routiner, such as Northeast Electronics 41 series of Service Analyzer Units. The Identifier operates on each call placed by the Routiner, and shows the telephone equipment item connected to the line during each call. If a call fails, the identification data can be used to isolate the faulty equipment for rapid repair and restoration to service.

1.6 Capacity for identifying any one of up to 100 possible equipment connections on each call is included in the standard Model 4101. Capacity may be expanded to a maximum of 800 connection points. Contact your sales representative for details.

1.7 The Identifier is designed for use by both maintenance and service analysis personnel. . . in troubleshooting equipment failures and in measuring service levels being delivered by operational equipment. The unit is fully automatic and requires no operator action except to note the identification readout on failed calls.

1.8 A typical application of the Model 4101 is shown in Figure 1—1. In this application, the Identifier is connected to the line bridging jack of a 41 series Service Analyzer Unit. A single sense wire is brought to a connector on the Model 4101 from each of the telephone equipment connection points to be identified. For example, the inputs to all register/senders in an office might be sense-wired to the Identifier. Each sense wire has a pre-assigned number (corresponding to its connector pin number) which appears on the Identifier's digital readout when that wire's telephone equipment is connected to a line during a call.

1.9 The Identifier is controlled by activity at the Service Analyzer's line jack. When a called number is outdialed by the analyzer (DP, TT, or MF), the Identifier transmits a recognition signal into the line. This signal passes through the telephone switching matrix to the common equipment then present on the line. Thus, the recognition signal appears on the Identifier's sense wire associated with the common equipment.

1.10 The Identifier performs a validity check on the recognition signal received over any sense wire and then displays the number of the telephone equipment assigned to the current call. The number remains displayed until a new call is initiated by the Service Analyzer Unit.

1.11 If a fault condition is detected by the Service Analyzer Unit, the user simply looks at the Identifier readout to determine the number of the specific telephone equipment item that was used on the failed call.

1.12 FUNCTIONAL DESCRIPTION

1.13 Figure 1—2 is a flow diagram of the basic operations performed by the Identifier. After the "power on" sequence, four distinct states are entered sequentially as follows:

- State 1 = ON HOOK (Idle)
- State 2 = OFF HOOK
- State 3 = TRANSMIT
- State 4 = IDENTIFY

The Identifier cycles through the four states each time a test call is placed from the associated Routiner. During State 1, the previous recognition is displayed unless power has been removed and reapplied. In this case 0.0.0. is displayed.

1.14 When an OFF-HOOK condition is detected, State 2 is entered and the display is blanked. If a Dial Pulse (DP) or Touch Tone® (TT) is detected, State 3 is entered immediately since this indicates that dialing is in progress. Otherwise, State 3 is entered three seconds later if neither DP or TT dialing is detected.

1.15 During State 3, a 12-kHz tone is transmitted from the Identifier to the common equipment under test during the first interdigit time. If a valid tone is received from the common equipment sense line, transmitting ceases and State 4 is entered. If a valid tone is not received within 200 milliseconds, State 4 is entered automatically.

1.16 During State 4, the display is unblanked and the identification is displayed on the front panel indicators. For a valid response, the number assigned to that sense line is displayed. If the identification is not valid (for example, something other than 12-kHz is received or excessive noise or low level signal), decimal points are illuminated with the number. If no signal is received during transmission of the 12-kHz signal, the display consists of three zeros with three decimal points.

1.17 When the Identifier senses an ON HOOK condition, it enters State 1 again and retains the previous display until power is removed or another OFF HOOK condition is sensed.

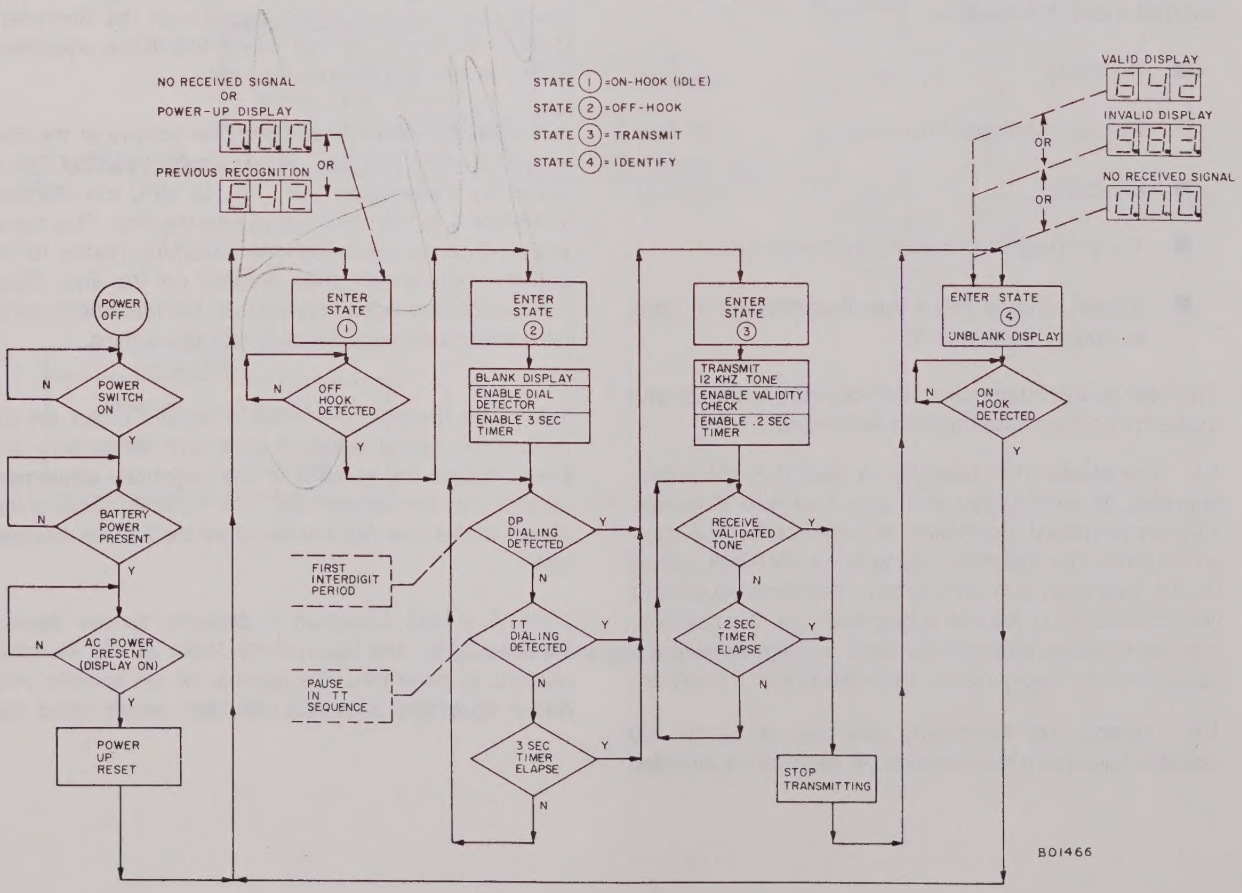


Figure 1—2. Flow Diagram

1.18 PHYSICAL DESCRIPTION (SEE FIGURE 1—3)

1.19 The Model 4101 Identifier is a modular unit consisting of an aluminum housing, a mother board and four plug-in pc boards. An additional board may be added to increase the line handling capacity from 100 to 200 lines. Thus, up to five plug-in modules may be used as follows:

Module	Part Number
1. Power Supply Module	4101-00-017
2. Transmitter Module	4101-00-015
3. Logic Module	4101-00-016
4. Diode Module	4101-00-012
5. Diode Module (Optional)	4101-00-012

1.20 If more than 200 lines are to be served, an extender card with a single rear panel connector is used in place of the second Diode Module. An Expander Module is cable-connected to the Identifier. This allows up to 7 additional Diode Modules to be inserted in the remote expander, providing identification for up to 800 lines total.

1.21 The front panel contains a POWER ON/OFF switch, a SELF-TEST pushbutton and a three digit LED display.

1.22 The rear of the Model 4101 comprises the panels attached to the individual modules. The modules are plugged into the mother board from the rear and are secured to the cabinet with screws. The mother board increases reliability by eliminating internal wiring. Test points and associated adjustments are accessible from the rear.

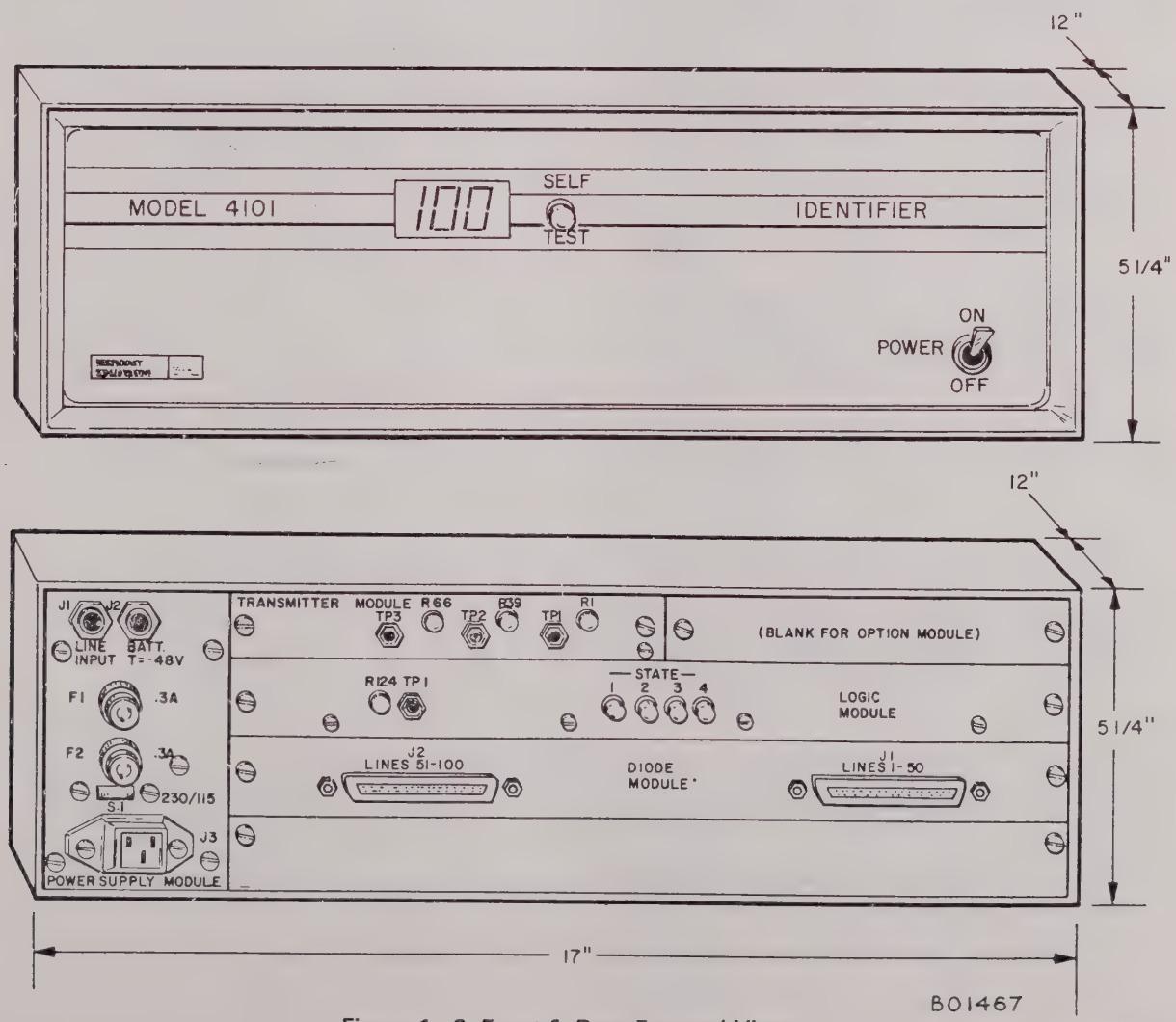


Figure 1—3. Front & Rear External Views

SECTION 2

SPECIFICATIONS

2.1 Major specifications of the Model 4101 Identifier are listed below.

2.2 ELECTRICAL PERFORMANCE

Capacity:

100 points standard. 200 points with second Diode Module. Up to 800 points maximum with optional expander unit and one 100-point module.

Sense Inputs:

May be wired to any point which has a metallic dc path to the Routiner during the identification interval.

Operating Modes:

a. Automatic initialization when power is applied. Displays 0.0.0.

b. For dial pulse (DP) calls, identification occurs during first interdigital period.

c. For TT or MF calls, identification occurs: (1) after end of complete dialing sequence, or (2) during any interdigital pause of at least 350 milliseconds.

d. If no dialing is detected, identification is attempted approximately 3 seconds after Routiner goes OFF HOOK.

e. Invalid identification is shown by lighting all decimal points. Absence of any valid identification signal is shown by lighting all zeros on readout, plus decimal points.

f. Automatic reset by sustained ON HOOK of at least 0.5 second by Routiner.

g. Self test can be done any time Routiner is on hook. Successful self test shown by displaying all 8's.

Recognition Signal:

The recognition signal does not interfere with normal telephone office operation. It is a tone burst lasting less than 200 milliseconds, transmitted at 10 V peak.

2.3 INTERFACES

Telephone Line Interface:
(LINE INPUT jack)

a. T/R connection to call originating line via 310 cord to line bridging jack on Routiner.

b. Off-Hook recognized when both Tip and Ring are more negative than −5.5 Vdc.

c. Minimum TT and MF levels are −10 dBm into 600 ohms.

Office Battery & Ground Interface: (BATT jack)	Requires 310 cord connection to battery (nominal −48 Vdc) on tip and ground on sleeve. Both battery and ground must be connected in order to enable ac power turn on.
Sense Wire Interface: (SENSE LINE J1 & J2)	A sense wire can be any length; however, length of total loop from Identifier LINE INPUT jack, through Routiner and telephone equipment, back to Identifier sense wire input must be less than approximately 250 feet for offices using 22 gauge wiring.

2.4 ROUTINER REQUIREMENTS

Routiner (service analyzer) used with the Model 4101 Identifier must meet the following requirements.

Dial Pulse Operation:	a. Any combination of pulsing rate and percent break within the shaded area of Figure 2−1 may be used. b. Interdigital time must be at least 350 milliseconds.
Touch Tone® or MF Operation:	Any combination of pulsing rate and percent tone shown in shaded area of Figure 2−2 may be used.
On-Hook:	For all types of dialing, an on-hook interval of at least 0.5 second is required between calls to reset the Identifier.

2.5 INPUT POWER REQUIREMENTS

117 or 234 Vac 10% at 20 watts, 40 to 440 Hz;
−48 Vdc ±12% at 250 mA

2.6 ENVIRONMENTAL REQUIREMENTS

Operating Temperature Range:	0° to 50°C (32° to 122°F)
Operating Relative Humidity:	0 to 90% noncondensing

2.7 MECHANICAL DATA

Size:	17" w x 5¼" h x 12" d (43.2 cm x 13.3 cm x 30.5 cm)
Weight:	10 pounds (4.6 kg)
Mounting:	Portable or 19" or 23" rack mounting

2.8 OVERLOAD PROTECTION

AC input protected with two 0.3 amp fuses located on rear of unit; −48 volt dc input protected with 0.5 amp fuse located inside Power Supply Module (see Figure 7−10); input ac and dc interlocked such that loss of dc removes ac input.

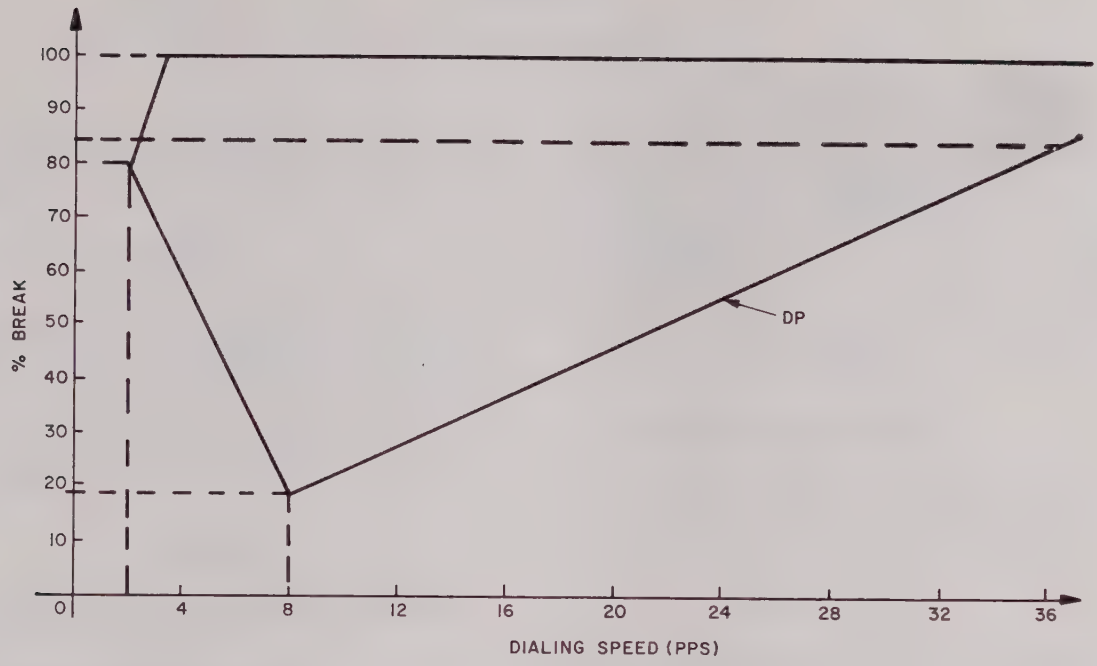


Figure 2—1. Typical DP Operating Range

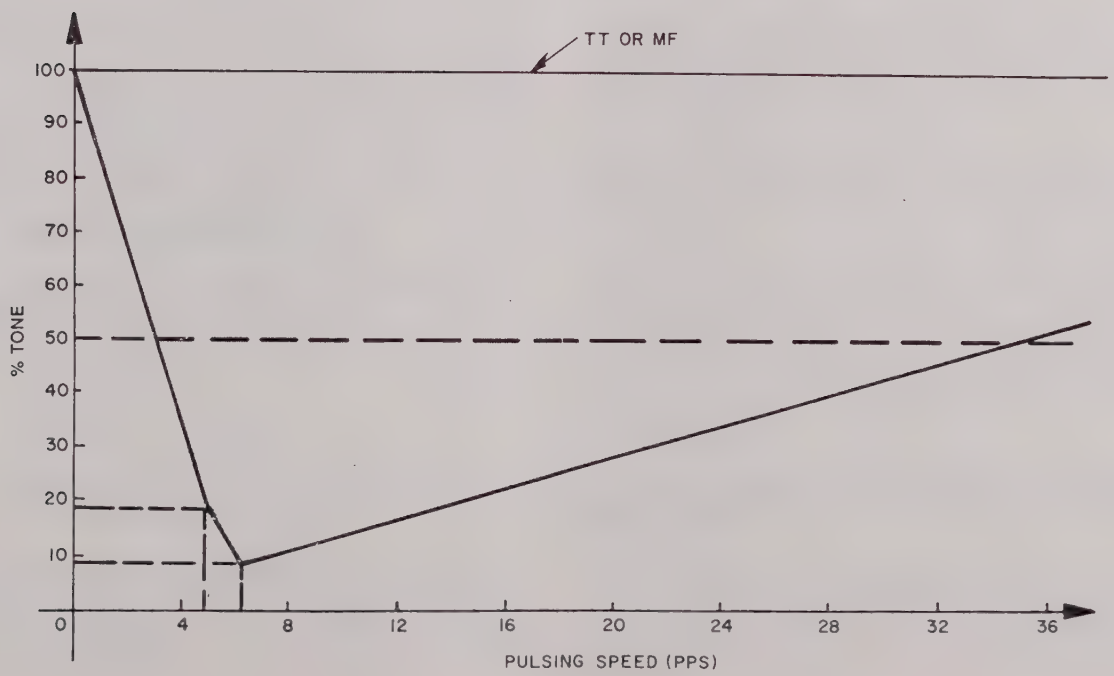


Figure 2—2. Typical TT & MF Operating Range

SECTION 3

INSTALLATION

3.1 This section provides information needed to install and checkout the Model 4101 to insure satisfactory performance.

3.2 VISUAL INSPECTION

3.3 After unpacking the Model 4101, visually check the exterior for any damage received during shipment. Check the rear panels and insure that all modules are secured in their correct locations by the screws on each end of the modules (refer to Figure 1—3 for module locations). Notify the common carrier immediately if any damage is found.

CAUTION

Do not attempt to operate the Model 4101 if damage is apparent.

3.4 SERVICE INFORMATION

3.5 Each instrument manufactured by Northeast Electronics is warranteed for a period of one year from date of delivery to the original purchaser. Complete warranty information is contained in the purchase order agreement under Terms and Conditions of Sale. Written authorization is required prior to the return of any equipment for factory repairs. Additional service information can be obtained by contacting Northeast Electronics, Customer Service Department, P.O. Box 649, Concord, New Hampshire, 03301, telephone number 603-224-6511.

3.6 LOCATION CONSIDERATIONS

3.7 The Model 4101 may be located anywhere, provided there is access to the following:

1. AC power source
2. Office battery and ground
3. BRIDGE jack on TTS 41-3 Service Analyzer (or equivalent Routiner).

It is usually convenient to locate the Model 4101 and the Routiner together; however, they may be separated as long as the cable limitations described in paragraph 3.8 are not exceeded.

3.8 The total loop length from the Identifier LINE INPUT jack to the Routiner, through the office switching equipment, to the identification points and back to the Identifier should be as short as possible. The maximum allowable length of this loop is approximately 250 feet for offices using 22 gauge wiring. Excessive loop distances and other wire sizes can be accommodated by increasing the level of the recognition signal transmitted by the Identifier (See paragraph 6.11).

3.9 MOUNTING PROCEDURE

3.10 The Identifier may be rack mounted or used as a portable unit. In either case, provide a minimum of 1-inch clearance from air inlets for proper cooling.

3.11 PORTABLE OPERATION

3.12 Place the Identifier on a table, shelf, mobile cart or on top of other related equipment such as an associated Routiner. Provide adequate clearance for cooling of both Identifier and Routiner.

3.13 RACK MOUNTING (SEE FIGURE 3—1).

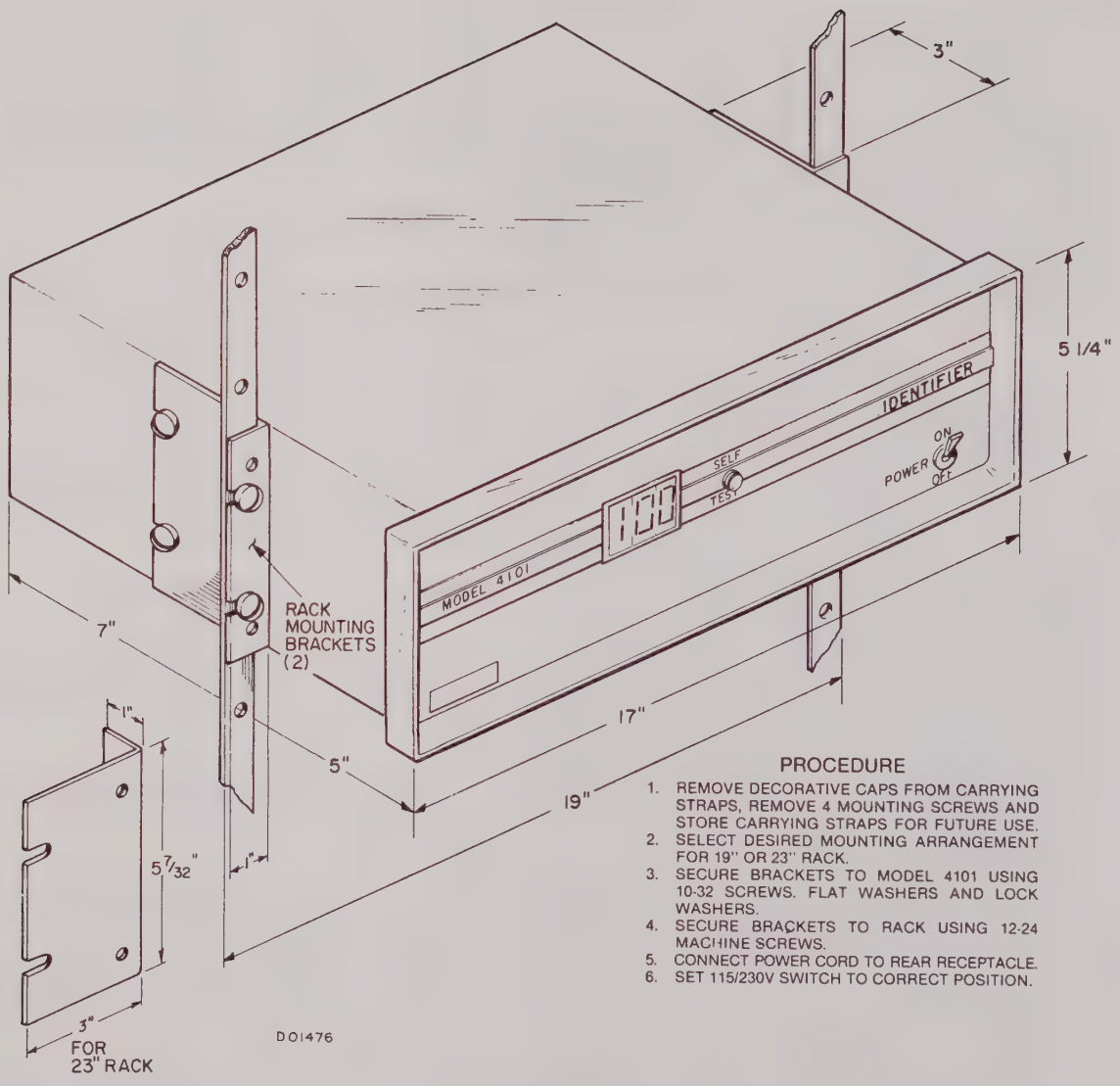
3.14 The Identifier is supplied with brackets for mounting in 19-inch or 23-inch racks. Refer to Figure 3—1 and install the brackets as required to accommodate the rack being used.

3.15 EXTERNAL CABLING REQUIREMENTS (SEE FIGURE 3—2)

3.16 Figure 3—2 shows the external cabling required between the Identifier, the Routiner and the Common Control equipment. Cabling is shown for the three Northeast routiners which may be used with the Identifier (i.e. TTS 41SAU-2, 41-3 and 41SAU-4 Service Analyzers). Refer to paragraph 3.25 for sense wire cabling instructions.

3.17 REAR PANEL CONNECTORS & CONTROLS (SEE FIGURE 3—3)

3.18 The rear panel of the Identifier is illustrated in Figure 3—3 and the functions of the associated controls and indicators used during installation are tabulated in Table 3—1.



PROCEDURE

1. REMOVE DECORATIVE CAPS FROM CARRYING STRAPS, REMOVE 4 MOUNTING SCREWS AND STORE CARRYING STRAPS FOR FUTURE USE.
2. SELECT DESIRED MOUNTING ARRANGEMENT FOR 19" OR 23" RACK.
3. SECURE BRACKETS TO MODEL 4101 USING 10-32 SCREWS. FLAT WASHERS AND LOCK WASHERS.
4. SECURE BRACKETS TO RACK USING 12-24 MACHINE SCREWS.
5. CONNECT POWER CORD TO REAR RECEPTACLE.
6. SET 115/230V SWITCH TO CORRECT POSITION.

Figure 3—1. Rack Mounting (19″ or 23″)

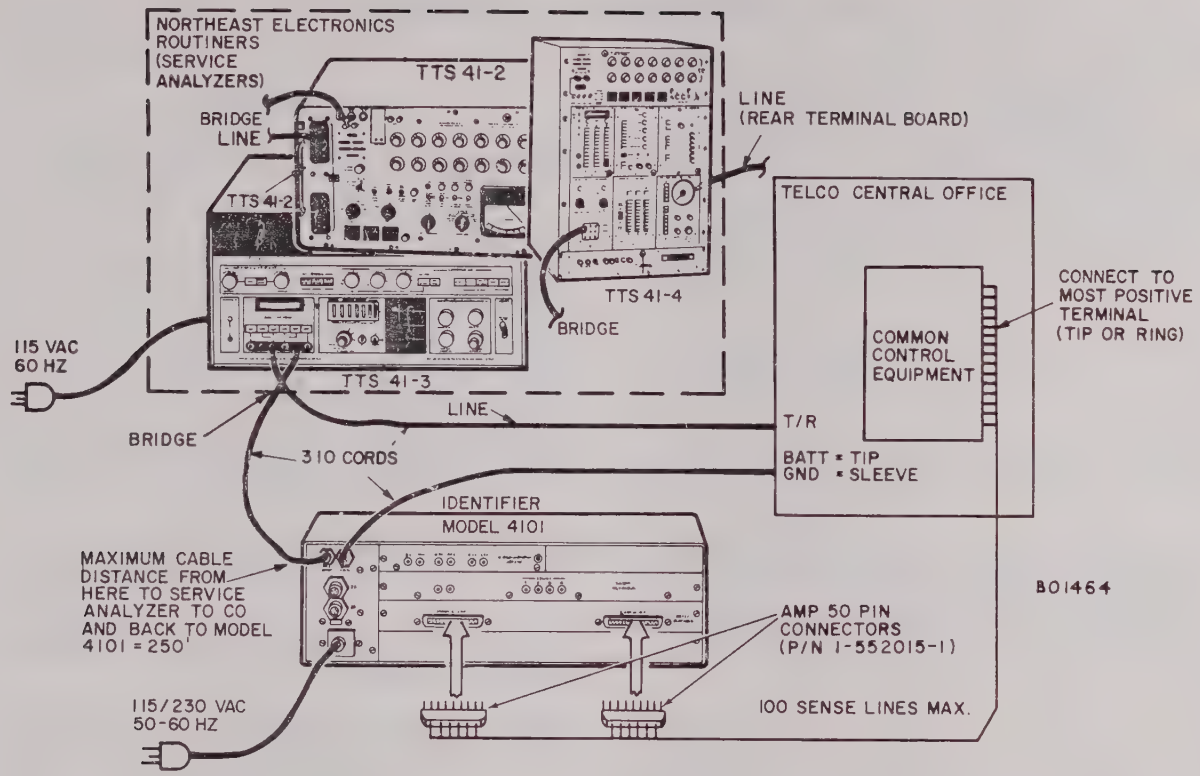


Figure 3—2. External Cabling

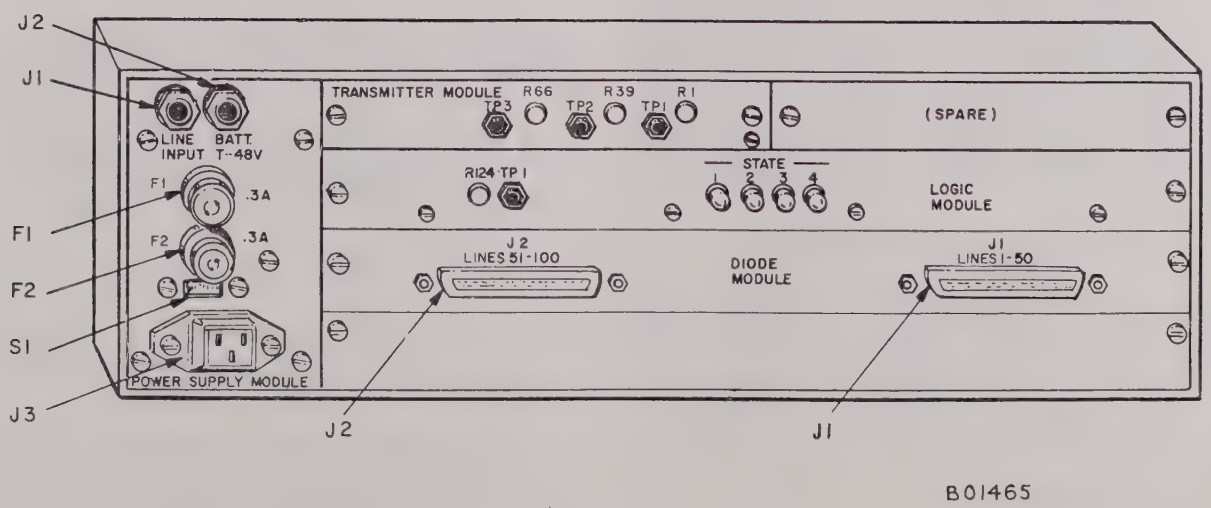


Figure 3—3. Rear Panel Controls & Connectors

Table 3—1. Rear Panel Controls & Connectors

REFERENCE DESIGNATOR	CONTROL, INDICATOR OR CONNECTOR	FUNCTION
POWER SUPPLY MODULE		
F1,F2	Fuse	AC line fuses, 0.3 ampere each.
J1	LINE INPUT	310 jack input for bridging connection to the Routiner
J2	BATT T = −48V	310 jack input for connection to office battery. Tip = −48 V, Sleeve = Ground.
J3	Power	115/230 Vac, power line input receptacle. Accepts the power cord supplied with the unit.
S1	230/115 Vac	Selects the ac input voltage range.
DIODE MODULE(S)		
J1	SENSE LINES 1-50	Accepts the first 50 sense wires from the office equipment to be identified.
J2	SENSE LINES 51-100	Accepts the second 50 sense wires from the office equipment to be identified.

3.19 AC POWER

3.20 The Identifier operates from 115 Vac or 230 Vac, 40 to 400 Hz power supplied by a NEMA standard 3-prong outlet plug on one end of a 7-foot power cord. The other end plugs into receptacle J3 on the Power Supply Module. The Identifier uses approximately 20 watts and contains two 0.3 ampere fuses for input power protection. A 115/230 Vac switch S1 connects the power source to the appropriate windings of an input power transformer in order to operate from either 115 or 230 Vac.

3.21 OFFICE BATTERY AND GROUND

3.22 This dc power is applied to connector J2 (BATT) of the Power Supply Module using a 310 cord connected to the Telco equipment. The tip is at −48 Vdc and the sleeve is at ground. Both BATT and AC Power must be applied before front panel power switch S2 can turn on the Identifier.

3.23 LINE INPUT

3.24 The LINE INPUT connector J1 is patched to the Bridge input of the Routiner being used via a 310 cord. This tip and ring connection supplies the outpulsed calling digits to the Identifier and also allows the Identifier to transmit the test tone.

3.25 IDENTIFICATION TEST WIRES

3.26 Sense lines are connected between points to be identified and the LINES 1—50 and LINES 51—100 jacks (J1 and J2) on the Diode Module.

The identification points must have the following characteristics:

a. The office switching equipment must connect only a single identification point to the Routiner's outgoing line during the identification interval.

b. The paths established from the Routiner to the identification points must pass direct current (metallic).

3.27 Connections to all 100 Identifier input connector pins are not required. Unused connector pins are ignored by the Identifier.

3.28 If the Identifier does not receive the test tone from an identification point during a call, it displays three zeros and three decimal points. This condition can occur for one of the following two reasons:

a. A failure occurs in the office switching equipment.

b. The call is serviced by a unit of telephone equipment which is not connected to one of the Identifier's sense wires.

For the previous reasons, it is recommended that one identification point be connected to the Identifier for every normal call.

3.29 The sense wires are connected to the Identifier with 50-pin Amphenol connectors on the rear of the unit. Two connectors are used to accommodate the 100 available sense inputs of the standard Model 4101.

3.30 The number assigned to each identification point is established by connecting the respective sense wire to the numbered pin of a plug which mates with connector J1 or J2 on the rear of the Identifier. The lowest numbered pin of each connector corresponds to the lowest identification number of that group. Other identification numbers are assigned sequentially within the connector. Figure 3–3 locates the Identifier connectors which accept numbers 1 through 100.

3.31 For 200 connections, two identical Diode Modules are used. Internal strapping distinguishes one module from the other.

3.32 CABLING & CHECKOUT PROCEDURE

3.33 The following procedure provides an orderly method for cabling and checking out the Model 4101 Identifier. Perform the following steps:

1. Visually inspect the Identifier as described in paragraph 3.2.

2. Mount the Identifier as described in paragraph 3.7.

3. Connect ac and office battery power to J3 and J2 respectively. Insure that the 115/230 ac voltage selector switch on the Power Supply Module is in the correct position.

4. Place the front panel POWER switch to the ON (up) position. The readout should display three zeros plus three decimal points. If this condition is not observed, the Identifier is not operating properly. Check to be sure that all modules are inserted properly and that **both** power connections have been made properly.

5. Press the front panel SELF TEST button. The readout should be blank initially and after about three seconds should display three eights with decimal points extinguished. If these conditions are not observed, the Identifier is not operating properly. Check to be sure all modules are properly installed in rear of unit.

6. Turn the POWER switch off and connect the sense wire inputs as shown in Figure 3–2.

7. Connect the LINE INPUT jack to the line bridging jack of the Routiner being used. Place the Routiner in the on-hook (idle) condition.

8. Turn the POWER switch on and repeat the self test. If the self test is performed correctly in step 5 above, but fails with sense input wires connected, one or more of the sense input wires may be improperly connected. Check the connections and repeat the self test.

9. When the self test is correct, the Identifier is ready for operation as described in Section 4.

3.34 IDENTIFICATION OF SENSE WIRE CABLES

3.35 The two 25 foot sense wire cables supplied with the Model 4101 Identifier are identical and should be installed as described in paragraph 3.15. Each cable is terminated on one end with a connector which mates with the connectors on the rear panel of the Identifier. The other ends are unterminated. They should be connected to the equipment to be identified according to the standard telephone color codes shown in Table 3–2. Note that each wire consists of a solid color and a tracer (striped color).

Table 3—2 Sense Wire Color Codes

Connector Pin No.	Solid Color	Striped Color (Tracer)
1	Blue	White
2	Orange	White
3	Green	White
4	Brown	White
5	Gray	White
6	Blue	Red
7	Orange	Red
8	Green	Red
9	Brown	Red
10	Gray	Red
11	Blue	Black
12	Orange	Black
13	Green	Black
14	Brown	Black
15	Gray	Black
16	Blue	Yellow
17	Orange	Yellow
18	Green	Yellow
19	Brown	Yellow
20	Gray	Yellow
21	Blue	Violet
22	Orange	Violet
23	Green	Violet
24	Brown	Violet
25	Gray	Violet

Pins 1-50 of J1 cable connector correspond to identification numbers 1-50.

Connector Pin No.	Solid Color	Striped Color (Tracer)
26	White	Blue
27	White	Orange
28	White	Green
29	White	Brown
30	White	Gray
31	Red	Blue
32	Red	Orange
33	Red	Green
34	Red	Brown
35	Red	Gray
36	Black	Blue
37	Black	Orange
38	Black	Green
39	Black	Brown
40	Black	Gray
41	Yellow	Blue
42	Yellow	Orange
43	Yellow	Green
44	Yellow	Brown
45	Yellow	Gray
46	Violet	Blue
47	Violet	Orange
48	Violet	Green
49	Violet	Brown
50	Violet	Gray

Pins 51-100 of J2 connector correspond to identification numbers 51-100.

SECTION 4

OPERATION

4.1 This section provides information needed to operate the Model 4101 Identifier.

4.2 CONTROLS AND INDICATORS

4.3 The functions of front panel controls and indicators are described in Table 4—2 and illustrated in Figure 4—1.

4.4 The rear panel controls and indicators are normally used during installation only. Their functions are described in Table 3—1. Test points and adjustments are described in Section 6, Maintenance.

4.5 OPERATING INSTRUCTIONS

4.6 Operation of the Identifier consists of simply turning the power on and performing a self test at the beginning of each operating session. However, certain operating parameters are necessary for use with the Identifier. These parameters are described in Table 4—1.

4.7 The Identifier operates automatically on each call placed by the Routiner. If a particular unit of telephone equipment is identified for several failed calls, that equipment is probably defective and may be removed from service for repair.

4.8 Routiners such as the Northeast 41 Series Service Analyzers may be programmed to stop operation and hold when a fault condition is detected. In this situation, the Identifier displays the identification until the Routiner is reset manually. Unattended operation of the Routiner and Identifier is possible when using the Routiner's "hold on fault" mode.

Table 4—1. Routiner Operating Parameters

PARAMETER	DIAL PULSE	TOUCH TONE® /MF
Pulsing Speed	Any combination within the shaded region of Figure 2—1.	Any combination within the shaded region of Figure 2—2.
Interdigital Time	350 milliseconds or greater	Not applicable.
On-hook time between calls	0.5 second minimum	0.5 second minimum
Wait-start-dial periods (TTS 41-3)	As desired	If a wait-start dial (WSD) period is programmed between digits of the dialed number, identification occurs during that period. Minimum WSD is 350 milliseconds. If a WSD is not included in the dialing program, identification occurs within 350 milliseconds after the end of the dialing sequence.

Table 4—2. Front Panel Controls and Indicators

REFERENCE DESIGNATOR	CONTROL, INDICATOR OR CONNECTOR	FUNCTION
S1	SELF TEST	Initiates the self test function. The Routiner must be in the on-hook state for the self test to function.
S2	POWER	Applies ac and office battery power. Both power sources must be connected for this switch to function.
U1-U3	LED Display	Displays the number of the sense point reached during the last call. This display is present until another call is placed or power is turned off.

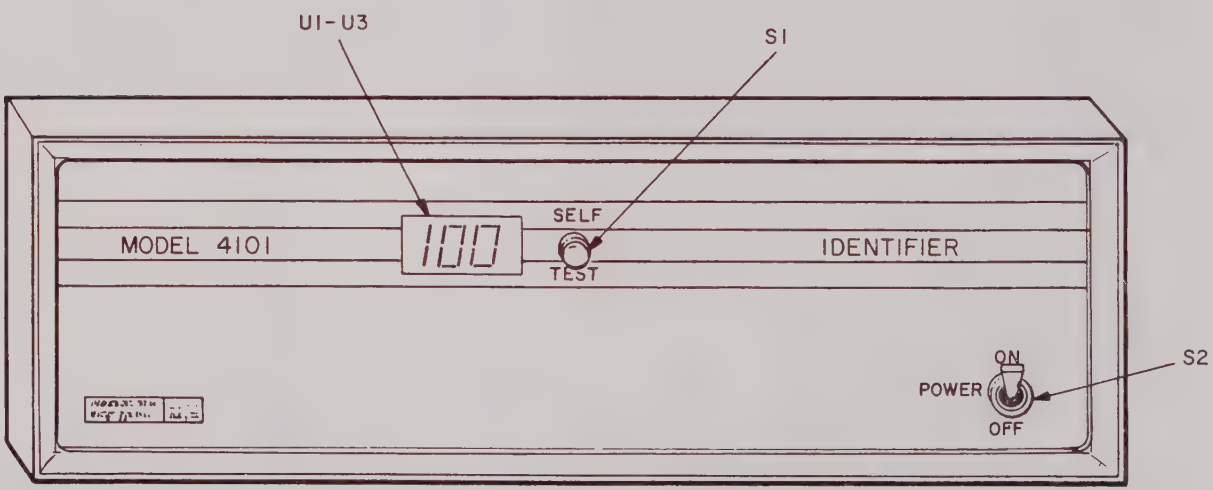


Figure 4—1. Front Panel Controls And Indicators

SECTION 5

THEORY OF OPERATION

5.1 This section describes the principles of operation. It includes a basic block diagram description and a detailed circuit analysis. The detailed analysis is written with reference to a functional schematic diagram showing all significant circuits, test points and adjustments. Refer to Figure 7—1 in Section 7 while following the detailed analysis.

5.2 BASIC BLOCK DIAGRAM DESCRIPTION (SEE FIGURE 5—1)

5.3 As shown in Figure 5—1, the Identifier's tip and ring input is connected to the BRIDGE jack of the Routiner being used to exercise the telephone equipment. This places the Identifier's tip/ring lines in parallel with the telephone line being routined.

5.4 When the Routiner is in the idle condition, the Identifier senses an ON-HOOK state. The Control Logic keeps the Identifier reset while retaining the previous identification on the LED display.

NOTE

When power is first turned-on, 0.0.0. is displayed until an identification cycle is initiated.

5.5 As a call is initiated from the Routiner, the Identifier senses the tip/ring OFF-HOOK condition and enters the OFF-HOOK state. Simultaneously, the Identifier determines the polarity of the tip/ring connection in order to make the correct seizure during test transmission. The Control Logic blanks the display, enables a 3-second timer and also enables dial detectors for both tone (TT or MF) and dial pulse (DP).

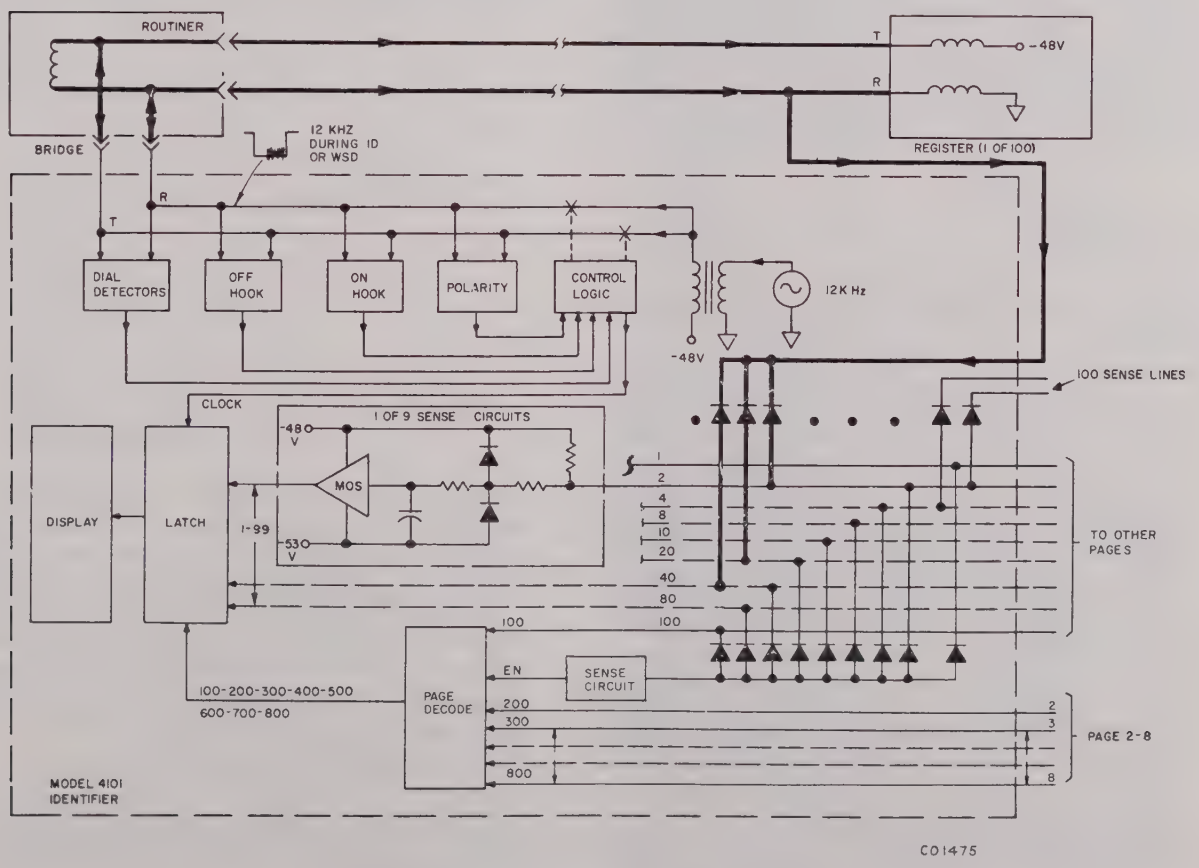


Figure 5—1. Basic Block Diagram

5.6 When a dialed number is detected, the Control Logic performs the following functions:

a. Seizes tip or ring, depending on the polarity determination made earlier.

b. Connects the 12 kHz oscillator to the seized connection when a pause in dialing is detected (interdigit interval in the case of dial pulse, WSD or end of dialing in the case of tone dialing).

5.7 If dialing is not detected within three seconds of the initial OFF HOOK transition, these functions are performed automatically.

5.8 As soon as the 12-kHz test tone is transmitted, a 200-millisecond timer is started by the Control Logic and a Validity Check Circuit (not shown) is enabled. Normally, one of the 100 sense lines connected to the telephone equipment under test completes the return path for the 12-kHz test tone to a diode matrix encoding network in the Identifier. If, for any reason, a return tone is not received within 200 milliseconds, the timer elapses and the Control Logic causes 0.0.0. to be displayed. This indicates no received signal. If the received signal is not a 12-kHz tone in phase with the transmitted tone, the decimal points are lighted along with the erroneous digits (e.g. 7.5.1.). This indicates receipt of an invalid signal. A valid signal is displayed as decoded without decimal points. Thus, the three typical types of displays for the Identifier are as follows:

No Signal Received	0.0.0.
Invalid Signal	7.5.1.
Valid Signal	4 8 3

A fourth display is provided for self-test. It consists of 8 8 8 .

5.9 As soon as a return tone is received, the 12-kHz oscillator is disconnected from the line. If no tone is received, the oscillator is disconnected when the 200-millisecond timer elapses. Thus, the maximum duration of the test tone is 200 milliseconds, beginning immediately after a pause in dialing is detected or 3 seconds after OFF-HOOK, whichever occurs first. When the oscillator is disconnected, the Control Logic clocks a Latch which stores the present identification and sends it to the display.

5.10 The 12kHz signal is referenced to −48V (standard version) or office ground (#5 XBAR version). The signal is applied to the side of the line which is of opposite polarity. For example, if TIP is at ground potential when circuits are ON-HOOK, the standard unit will connect the 12 kHz signal, referenced to −48V, to Tip during the identification interval. This technique has two advantages:

1. The switch train will not be affected by the application of this signal. All relays held operated by the OFF-HOOK condition will remain operated.

2. The 12 kHz signal will swing more negative than office battery (or more positive than office ground). Since no other signal in the telephone office has this characteristic, the signal may be positively identified.

5.11 The 12-kHz signal present on one of the 100 input sense lines is encoded from decimal (1-100) to 9-bit BCD equivalent (1,2,4,8,10,20,40,80, & 100). This is accomplished by a diode matrix whenever a return tone is received. Nine sense circuits are connected to the BCD lines to provide inputs to the Latch. An additional sense circuit is connected to all nine input lines through isolation diodes. When any one or any combination of the nine lines receives a return tone, this sense circuit enables a Page Decoder circuit.

5.12 The Decoder receives the "hundreds" input from the ninth sense line for group 1-100. It also receives additional inputs from other groups of sense lines (other diode modules, if used), to provide display data for lines 101 through 800.

5.13 Each group of 100 lines is referred to as a "page" with the following relationship to the actual sense line number:

Page Number	Sense Lines
1	1 — 100
2	101 — 200
3	201 — 300
4	301 — 400
5	401 — 500
6	501 — 600
7	601 — 700
8	701 — 800

The output of the page encoder is applied to the Latch along with 8 of 9 sense line inputs. The sense lines provide a count from 1 to 99 while the Page Encoder supplies the "Hundreds" increment depending upon which "page" detects the 12-kHz test tone. The Latch is clocked as soon as the transmitted 12-kHz tone is received or when the 200-millisecond timer elapses. Whatever data appears on the input sense lines at that time is held in Latch and appears on the display until another recognition cycle is initiated.

5.14 When the ON-HOOK condition is sensed, the Control Logic resets the Identifier in preparation for another identification.

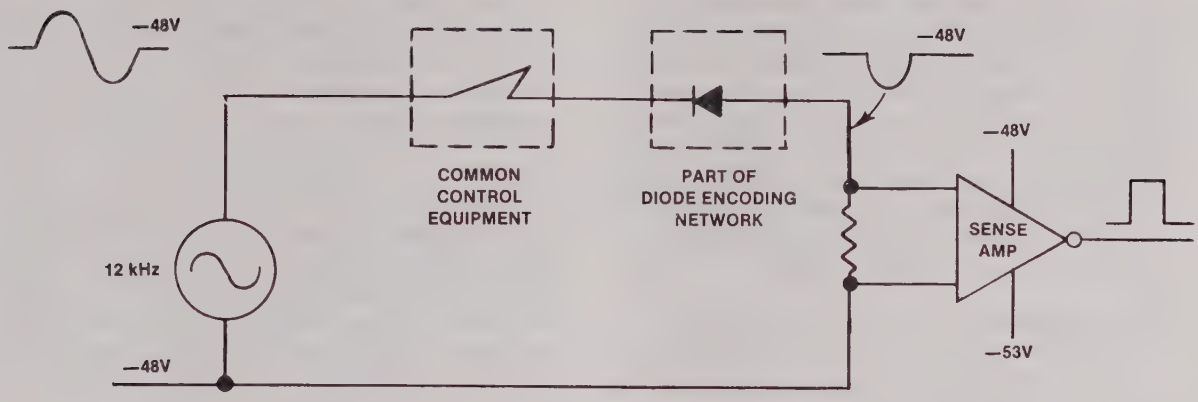


Figure 5—2. 12 kHz Signal Reference

5.15 FUNCTIONAL SCHEMATIC DESCRIPTION (SEE FIGURE 7—1)

5.16 The following paragraphs describe operation of the Identifier in each of its four states, the sequence followed during application of power and the operation during self-test. Figure 7—1, a functional schematic, should be followed while reading this description. The order of presentation is:

1. Power-On Sequence
2. Power Reset Cycle
3. Tip/Ring Detector Operation
4. State 1 (ON-HOOK/Idle)
5. State 2 (OFF-HOOK)
6. State 3 (TRANSMIT)
7. State 4 (DISPLAY)
8. Self-Test

NOTE

On the functional schematic, the arrow symbol is used to indicate a change of state. For example, →3 means "go to State 3".

5.17 POWER-ON SEQUENCE

5.18 DC power for operation of the Identifier is obtained from the telephone equipment via a 310 cord with −48 Vdc on the tip and ground on the sleeve. The ring connection is not used. AC power is provided by a local 115 or 230 Vac source. Both dc and ac inputs connect to the Power Supply Module. As described previously, both inputs are necessary. If either is missing, the Identifier is inoperative.

5.19 Closing the Identifier's POWER switch applies −48 Vdc to the coil of relay K1 through fuse F3 and reverse voltage protection diode CR13. Ground is applied to the other side of relay K1 continuously. This energizes K1, which switches the dc ground and −48Vdc to the Identifier circuitry and also switches one leg of the ac input through fuse F2 to the primary of transformer T1 and voltage select switch S1. The other ac leg is fused by F1 and connected to the bottom of T1 and S1.

5.20 Switch S1 controls the ac voltage across the split primary winding of T1 to accommodate 115 or 230 Vac power sources. In the 230 Vac position, it shorts the split connection so the two primary windings are in series. This places 115 Vac across each half when 230 Vac is applied to the input. In the 115 Vac position, S1 connects the two primary windings in parallel which also places 115 Vac across each half when 115 Vac is applied to the input.

5.21 The three secondary windings of T1 provide stepped-down voltages of 20 Vrms to the +12 Vdc and −12 Vdc power supplies and 12 Vrms to the −53 Vdc power supply. The −53 Vdc output is actually a 5-volt supply referenced to −48 Vdc rather than ground. It is used for the MOS circuits which interface with the sense lines from the telephone equipment. The +12 Vdc is used for all other MOS logic circuits in the Identifier.

5.22 POWER RESET CYCLE

5.23 When power is initially applied, the +12 Vdc power supply enables a power-on reset circuit on the Logic Module. The RC network is at ground potential

initially and then charges toward +12 Vdc until the threshold of U27-D is crossed approximately 150 milliseconds later. This initial low level (RESET) is inverted by U27-D and resets decimal counter U26. The 0 output of U26 goes high, lighting the STATE 1 lamp on the rear panel via driver U21-A. The low RESET pulse is also inverted by U31-B which resets VALID latch U25-B and DISPLAY latch U20-B. Chip U19B inverts RESET to clear SELF-TEST flip-flop U20A. Thus, the following flip-flops reset whenever power is applied:

1. Decimal counter U26
2. VALID latch U25-B
3. SELF-TEST flip-flop U20-A
4. DISPLAY latch U20-B

5.24 TIP/RING DETECTORS

5.25 Operation of the Identifier subsequent to the Power-On cycle is controlled by activity on tip and ring of the LINE INPUT jack. This ensures that the identification process is coordinated with the operation of the associated Routiner.

5.26 Tip and ring activity is determined by four detector circuits located on the Transmitter module. These circuits generate line status signals which serve as inputs to the Control Logic on the Logic Module. Operation of the line status detectors is discussed in the following paragraphs. (Refer to Figure 5—3 for this discussion).

5.27 ON-HOOK and OFF-HOOK conditions are detected by examining the dc potential of tip and ring. OFF-HOOK is defined as the condition in which both tip and ring are more negative than —5.5 Vdc; ON-HOOK is detected when either tip or ring are more positive than —5.5 Vdc. U2-A and U2-B compare tip and ring potentials with a —5.5 Vdc threshold. The outputs of these operational amplifiers go to +12 Vdc when the corresponding inputs are below —5.5 Vdc.

5.28 The outputs of U2-A and U2-B are OR-ed together by diodes CR13 and CR15. Thus, TP4 reflects exactly the ON/OFF HOOK status of tip and ring; +12 Vdc corresponds to OFF HOOK, —12 Vdc corresponds to ON-HOOK.

5.29 The signal at TP4 is not used directly; rather, timing circuits buffer this signal to a form more useful in controlling the operation of the set. Basically, the ON-HOOK signal at the output of U3B is filtered to ignore dial pulses, while the OFF-HOOK signal is filtered so as to reject noise pulses yet respond to dial pulses.

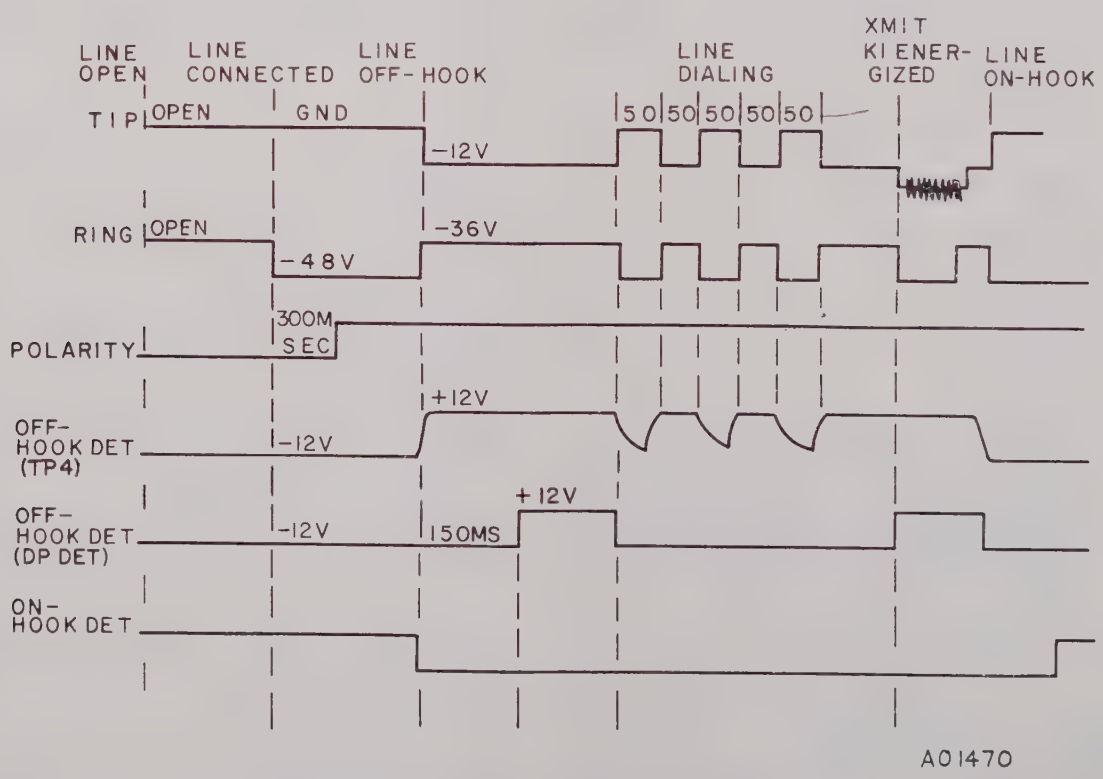


Figure 5—3. OFF-HOOK/ON-HOOK Timing Diagram

5.30 Components CR16/R37/C16 make up the ON-HOOK filter. ON-to-OFF-HOOK transitions (−12V to +12V) cause C16 to charge immediately through CR16 towards +12V. When the 0 Vdc threshold is crossed (in approximately 1.9 ms) the output of U3B goes negative to the ON-HOOK state. OFF-to-ON-HOOK transitions (+12 Vdc to −12 Vdc) cause C16 to discharge slowly towards −12 Vdc through R37. When the zero volt threshold of U3B is crossed, (in approximately 0.3 second) its output goes to the high (ON-HOOK) state. Thus, the ON-HOOK signal responds rapidly to OFF-HOOK conditions, but requires 0.3 second to recognize the ON-HOOK condition. Dial pulses are therefore ignored by this circuit.

5.31 Two similar RC networks filter the TP4 potential to produce the OFF-HOOK signal. R36/CR14/C8 produce approximately 25 msec of delay in detecting OFF-to-ON-HOOK transitions. This delay corresponds to the minimum width of a dial pulse which is within the operating envelope of the Identifier (Figure 5−4). Thus, dial pulses will be passed by the circuit and noise pulses less than 25 msec in duration will be ignored. An adjustable threshold is provided to allow the minimum pulse width (and hence noise margin and operating envelope) to be varied.

5.32 The second delay circuit (CR17/R43/R44/C9) produces a delay of approximately 100 msec in detecting ON-to-OFF-HOOK transitions. This delay is necessary to differentiate between OFF-HOOK intervals in the pulsing of a single digit and the inter-digit period between dialed digits. After a dial pulse (or other ON-HOOK condition of more than 25 msec) has occurred, an OFF-HOOK interval of more than 100 msec will be interpreted as an inter-digit period, and the output of U6B will change state.

5.33 Thus, the output of U6B will be high when the line is OFF-HOOK and low when ON-HOOK. It will also go low approximately 25 msec after the first pulse of a dialed digit has occurred and will stay low until approximately 100 msec after the last pulse of the digit has occurred.

5.34 The POLARITY signal is generated by operational amplifiers U5A and U5B. The polarity of the line is detected during the ON-HOOK period by U5A. Its output is maintained by network R25/C7 for approximately 0.3 second after the line is seized (i.e. goes OFF-HOOK) by the Routiner. This delay is necessary to permit the control circuits to use the polarity information when the delayed OFF-HOOK signal (U6B output) goes high 100 msec after the line changes state.

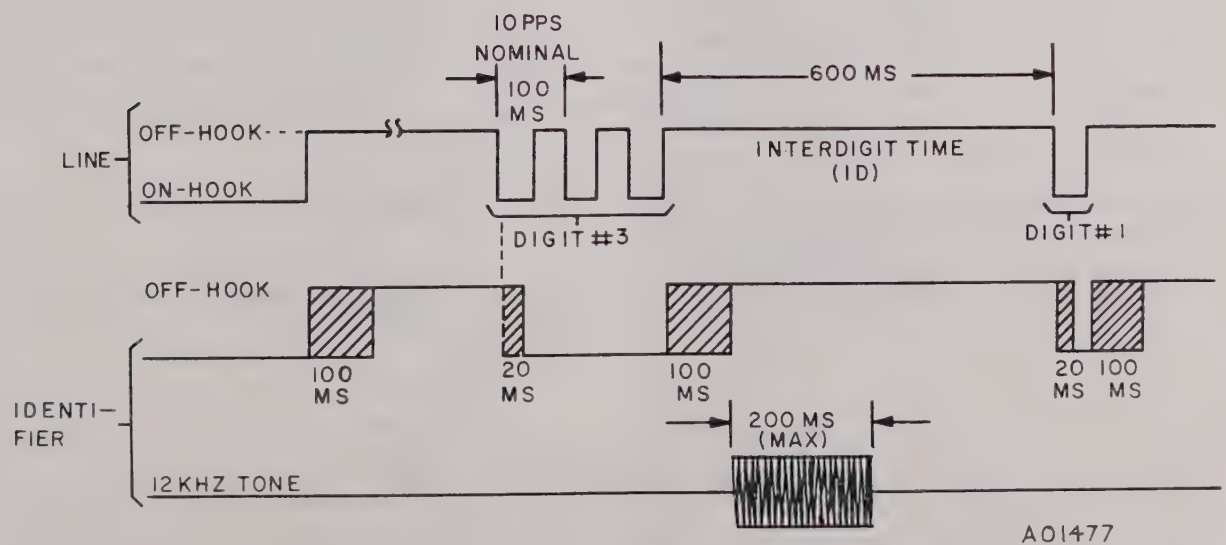


Figure 5−4. DP Timing Detection

5.35 Finally, a filter/detector circuit is provided to detect the presence of Touch-Tone ® signals (See Figure 5—5). T2/U8A and the 700-1500 Hz Filter select the high frequency tone of the Touch-Tone® pair. This filter eliminates noise and dial tone signals. The resulting signal is rectified by CR22/R27/C26/R45 to produce a pulse which corresponds to the Touch-Tone® envelope. Delays are provided such that a Touch-Tone® pulse of at least 7.8 msec is required for recognition and a pause of 100 msec is required before a wait-start-dial interval is recognized. Since transmission of the test signal will occur when the output of U6A falls, this voltage must remain high until a pause of sufficient width occurs in the Touch-Tone® sequence. The 100 msec delay is sufficient to ignore inter-digit periods in Touch-Tone® sequences which are within the operating envelope of the Identifier. The operator must guarantee that when a pause of more than 100 msec occurs, it will last long enough (350 msec) for the identification signal to be transmitted.

5.36 STATE 1 (ON-HOOK)

5.37 After the Power-On sequence has occurred, the Identifier will remain in State 1 until the Routiner seizes the line (goes OFF-HOOK) to place a call. State 1 is maintained by the reset applied by the ON-HOOK signal via U27D to shift register U26.

5.38 STATE 2 (OFF-HOOK)

5.39 State 2 is entered when a tip/ring off-hook condition is sensed on the LINE input. The Transmitter Module senses the change and causes the ON-HOOK signal to go low immediately and sends a high OFF-HOOK signal to the Logic Module 100 msec later. This removes the reset from U26 and advances shift register U26 to State 2 and lights the State 2 lamp. The Identifier is then ready to detect TT or DP dialing and enter the transmit cycle (State 3).

5.40 Simultaneously with the detection of OFF-HOOK, the Transmitter Module determines the relative polarity of the tip and ring. During the transmit cycle, the output of the 12-kHz oscillator is connected to the more positive line as determined during ON-HOOK.

5.41 The OFF-HOOK and POLARITY signals are applied to the Logic Module. The high OFF-HOOK signal is gated with the high STATE 1 signal by U27A. The resulting low output clocks D flip-flop U23B which: (a) sets if the POLARITY signal is high (tip positive), or (b) resets if POLARITY is low (tip negative). The output of U23B is gated to relays K1 or K2 on the Transmitter Module during STATE 3 to seize the tip or ring output.

5.42 The low signal at the output of U27A enables shift register U26 via U31 and U32, allowing it to be clocked by the positive half-cycle of the 12-kHz reference signal from the test oscillator on the Transmitter Module. The counter's low ENABLE input allows **one** clock pulse to advance the count to 1 (STATE 2). At that time STATE 1 goes low which disables U27A and the shift register.

5.43 During States 2 and 3, the LED display is blanked via gate U32A whose low $\overline{\text{BLANK}}$ output resets 4-to-7 LINE DECODERS U14, U15 and U11. VALID flip-flop U25B is reset by STATE 2 via U31B in preparation for the next identification cycle.

5.44 The high STATE 2 signal removes the reset applied to flip-flop U23A. This flip-flop is now ready to detect the next ON-to-OFF-HOOK transition. Referring to Figure 5—3, this transition will occur 100 msec after the end of the first dialed digit.

5.45 STATE 2 also enables gates U27B, U28D, U27C and starts 3-second timer U30. These gates will pass signals which indicate the end of the first dialed digit, a pause in a Touch-Tone® sequence and the end of the 3-second timer interval respectively. The first of these events to occur will enable shift register U26 to be clocked to STATE 3.

5.46 STATE 3 (TRANSMIT)

5.47 During STATE 3 the 12 kHz test tone is transmitted to the unit under test on tip or ring of the line.

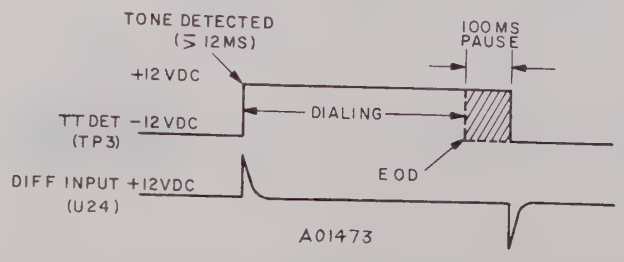


Figure 5—5. TT Detection Timing

5.48 STATE 3 is entered in a manner identical to the transition to STATE 2. When either the end of the first dialed digit or a pause in Touch-Tone® dialing is detected or the 3-second timer interval elapses, the output of U31A will go high, U32B will go low and shift register U26 will be enabled. A positive edge of 12 kHz will cause shift register U26 to enter State 3. This action removes the high STATE 2 signal from gates U27C,U27B and U28D and hence, the enable to U26 will be removed.

5.49 STATE 3 (Transmit) keeps the display blanked via U32A, U32C and U32D while the 12-kHz tone is transmitted. The low $\overline{\text{BLANK}}$ output of U32A also keeps the VALID line high during STATE 3 by reverse biasing CR38. This keeps the decimal points on the display blanked also. The VALID DETECTOR (U25A) and the VALID latch (U22B) are released from the reset state by the low $\overline{\text{STATE 3}}$ in preparation for detecting and storing the results of the test transmission when the Identifier leaves STATE 3.

5.50 The low $\overline{\text{STATE 3}}$ signal also releases 200-millisecond timer U29 from the reset state. This is a 14-stage binary counter which is incremented by the 12-kHz square wave reference signal from the Transmitter Module. At a count of 2048, the Q_{12} output goes high. With an input clock rate of 80 microseconds, this corresponds to 164 milliseconds, nominally. If a valid test tone is not received before this time elapses, shift register U26 is incremented to STATE 4 automatically. Thus, the maximum transmit time is less than 200 milliseconds under worst case conditions.

5.51 STATE 3 enables U19C and U19D. Depending upon the relative polarity of the tip and ring inputs, as stored in POLARITY flip-flop U22B, either $\overline{\text{SEIZE TIP POS}}$ or $\overline{\text{SEIZE RING POS}}$ goes low and energizes relay K1 or K2 respectively, on the Transmitter Module. This connects the output of the 12-kHz oscillator to either the tip or ring (depending on which is the more positive) via transformer T1, the energized contacts of K1 or K2 and the de-energized contacts of SELF-TEST relay K3.

5.52 Relay K1 or K2 also produces a signal called the TRANSMIT WINDOW which lasts for the duration of the transmit cycle (STATE 3) and is used to enable the sense circuits located on the Logic Module.

5.53 The 12-kHz oscillator on the Transmitter Module consists of operational amplifier U1, FET Q1, LEVEL adjust R1 and associated components as shown in Figure 5—6. This is a Wien-Bridge oscillator consisting of a series reactance leg (R6 and C5) and a shunt reactance leg (R5 and C3). These components determine the oscillator frequency. Negative feedback is provided through R3 and R4 to control the output amplitude. The resistance of R4 is varied by Q1 to stabilize the amplitude. The resistance of Q1 is determined by the dc gate voltage provided by rectifier circuit CR1, R1 and R2.

5.54 Another 12-kHz REFERENCE signal is applied to the Logic Module to determine the validity of the received tone using a phase comparison technique. This signal is a square wave at MOS logic levels (+12 Vdc and ground) derived from transistor amplifier-clipper Q2 and Q3 on the Transmitter Module.

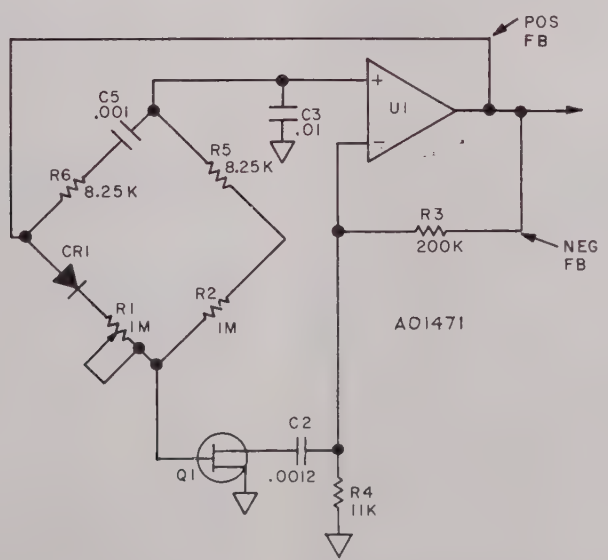


Figure 5—6. 12-kHz Wien-Bridge Oscillator

5.55 Resistor R1 is normally adjusted for approximately 20-volt p/p at TP1 (Line Input). If sense lines longer than 200 feet are used, this level may be increased up to 40 volts p/p in order to provide a reliable received signal. (See paragraph 6.11).

5.56 Transistor pairs Q4 and Q5 and Q6 and Q7 are arranged in a Darlington configuration to provide a push-pull driver for line transformer T1. One pair provides the drive during positive half-cycles and the other during negative half-cycles.

5.57 The 12 kHz tone is transmitted along the selected side of the line (Tip or Ring) to the piece of common control equipment being used to service the current call. The diode encoding network receives 12-kHz tone on any 1 of 100 (or 200) sense lines. It encodes it into BCD for recognition by Line Decoders U11, U14 and U15 on the Logic Module. This is a straight forward encoder with Sense Lines 1-100 connected via diodes to the corresponding BCD bit lines. For example, sense line 3 is connected to BCD bits 1 and 2; line 99 is connected to BCD bits 1,8,10 and 80, and so forth.

5.58 Each BCD sense line is biased to office battery (−48V) by the sense amplifiers. When the 12-kHz signal is received on an input line, the associated encoding diodes become forward biased by the negative excursions of the signal. The signal is referenced to −48V; thus, the peak-to-peak excursion is approximately ±10V from −48V.

5.59 The 12-kHz signals are filtered and detected by CMOS inverters and are then gated with the SELF TEST signal from the Transmitter Module. This signal is present during the transmit interval; therefore, the sense circuits are active only when the 12-kHz signal is being transmitted.

NOTE

The MOS logic chips used in the sense circuits are operated between −48 and −53 Vdc with a potential difference of 5 volts.

5.60 The output of each gate is level shifted and the signal is converted to a dc voltage. The transistor switches convert each half-cycle of 12 kHz into a −53V to +12V pulse; the portion of each pulse which exceeds ground potential forward biases the following diode and charges a 0.1 microfarad capacitor towards +12 Vdc. When sufficient pulses have been received, the capacitor voltage will exceed the threshold voltage of the associated inverter and its output will go low.

5.61 Thus, the inputs to the unit's and ten's latches U16 and U17 are low if the corresponding sense lines have received 12 kHz and are high (+12 Vdc) otherwise.

5.62 The hundreds digit of the display is generated from the page signals and sense line 100. The page line indicates which one of 8 possible groups of lines have received the 12 kHz signal. The page signals are encoded into BCD such that the BCD value is equal to the page number minus one. The result is then added to sense line 100. For example, if the 12 kHz signal is received on circuit number 131, the page two line (circuits 101-200) will be active. Page two will be decoded to BCD one and since the 100 line is inactive, the hundred's digit will be 1. However, when circuit 200 is received, the 100 line will be active and, when added to the BCD 1, will cause the display to indicate 2.

5.63 The page signal is generated on each diode matrix module by summing the signals from the 9 sense lines with diodes. The summed signal is detected and converted to a dc level in the same manner that the BCD signals are generated. Thus if any one of the 100 input lines of a page receives the 12 kHz signal, the page line of that module goes active.

5.64 The page designation of each diode module is programmed by connecting a strap to the appropriate pin. Clearly each Diode Matrix module used in an Identifier unit must be given a unique page designation to avoid confusion.

5.65 The 12 kHz page signals from each diode matrix module are summed at pin X of the diode matrix modules. This signal, called "sum of the sense" (Σ sense) is therefore a 0-12V 12-kHz pulse train equal in frequency to the transmitted signal. The Σ sense signal is, however, delayed slightly in phase due to the 0.7V clipping level of the matrix diodes.

5.66 The Σ Sense signal is compared to the 12 kHz reference signal to ensure that the signal is valid. This check ensures that the signal is, indeed, the transmitted signal and that it is of sufficient quality to make a reliable identification. The validity check is made by comparing the phase of the Σ Sense signal with the 12 kHz reference signal.

5.67 Since positive edges of Σ Sense should trail positive edges of 12 kHz REF, flip-flop U25A will be clocked to the set state when a valid signal is received. If the valid condition lasts long enough (approximately 100 msec), valid flip-flop U25B will be clocked to the set state when capacitor C28 charges to the threshold voltage at its clock input.

5.68 The resulting valid signal causes the display's decimal points to be extinguished (via switch Q10). and, since State 3 is active, the valid signal is passed through to the output of gate U28C. This signal clocks latch U20B and enables shift register U26 via gate U32B. The next positive-going edge of 12 kHz REF clocks

the state shift register to State 4. The output of U28C then goes low.

5.69 If a valid condition is not received before timer U29 has timed out, the latch will be set and the state shift register advanced to State 4 via the timer output and U28B and U28C.

5.70 STATE 4 (DISPLAY)

5.71 State 4 is entered when the 12-kHz tone is received or the 200-millisecond timer elapses. At that time, $\overline{\text{BLANK}}$ goes high and whatever recognition is made (valid, invalid or no received signal) is displayed with or without decimal points, as appropriate. The Identifier remains in State 4 until an ON-HOOK is detected. It then goes to State 1 in preparation for the next cycle of operation. The display is unblanked until the line goes OFF-HOOK and the Identifier enters STATE 2.

5.72 Latches U9, U16 and U17 are clocked by the LATCH pulse from flip-flop U20B which sets when State 4 is entered via U28C and either U28A or U28B. Whatever number is decoded at that time is stored in the latches until it is replaced during the next recognition cycle.

5.73 The four BCD bits for the units, tens and hundreds digits are applied to 7-segment decoders U11, U14 and U15 which are enabled during States 4 and 1. These chips provide a 7-line output based on the four input bits and form any digit from 0 to 9. The 7 output lines from each chip are applied to drivers U10, U18 and U22 which provide the current to light the LED's.

5.74 The display is switched on and off at a 12 kHz rate by the 12 kHz REF signal. The switching rate is undetectable to the eye but reduces the total current required by the LED display.

5.75 Entering State 4 disables U19C and U19D which de-energizes K1 or K2 and removes the 12-kHz test tone from the line. If an ON-HOOK signal of sufficient duration (approximately 300 ms) is detected, shift register U26 resets to 0 (State 1) via U27D. ON-HOOK is detected by U2B and U3B on the Transmitter Module as described previously. The unit is now ready to repeat the identification process on the next call.

5.76 SELF-TEST OPERATION

5.77 Pressing SELF-TEST switch S1 on the front panel clocks flip-flop U20A via U19A. If the Identifier is in State 1 (ON-HOOK received or initial power-up), the flip-flop sets to initiate the SELF-TEST operaiton, The low $\overline{Q}$ output of U20A keeps the CLK input high to prevent switch contact bounce from resetting the flip-flop. It also inhibits decoder U7 (EN is low) while the high Q output forces an "8" into the word B input of adder U8. This provides the hundreds portion of the "888" display for a valid self-test.

5.78 The low SELF-TEST $\overline{Q}$ output of U20A is inverted by U10 on the Transmitter Module which energizes K3. The TEST LINE is always at approximately −9 Vdc from voltage divider R30,R31,R47 and CR25 on the Logic Module. It is switched through K3 onto the TIP and RING inputs of the Transmitter Module. Because both TIP and RING are more negative than −5.5V, the following circuits detect an OFF-HOOK condition and initiate the sequence of events from State 1 to 4.

5.79 OFF-HOOK is detected by U2A, U3A and U6B as described previously. It clocks decimal counter U26 to State 2 via U27A, U31A and U32B. State 2 starts 3-second timer U30 which elapses since no dialing is detected during self-test. After 3 seconds, State 3 is entered via U27C.

5.80 As soon as K3 energizes during State 1, the −9 Vdc on the Tip and Ring inputs is sensed by polarity detector U5A. Voltage dividers on the positive and negative inputs (not shown on Figure 7−1) cause the negative input to be the more positive input. The POLARITY signal goes to −12 Vdc and flip-flop U23B on the Logic Module remains reset when clocked by STATE 2. When STATE 3 is high, $\overline{\text{SEIZE RING POS}}$ goes low via U19D. This energizes K2 and the 12-kHz test tone is applied to the TEST LINE via the contacts of K3.

NOTE

During SELF-TEST, the tip and ring connections to the LINE output jack are open circuited by K3.

5.81 The 12-kHz test tone activates the Page Sense circuit via CR324 on the diode Module. The Σ SENSE output goes high and is applied to VALIDITY flip-flop U25A on the Logic Module. As described previously, U25A and U25B set if the test tone is in phase with the 12-kHz REFERENCE signal. This increments the decimal counter to State 4, generates the LATCH signal, inhibits lighting the decimal points, de-energizes K2 and enables the display.

5.82 The 12-kHz tone is applied to Sense Lines 4 and 8 (BCD 8 and 80) via CR13 and CR18. This energy is detected and latched into U9, U16 and U17 along with the BCD 800 from adder U8. Thus, the final display for a successful SELF-TEST is 8 8 8.

5.83 STATE 4 high resets SELF-TEST flip-flop U20A which de-energizes K3. This removes the −9 Vdc TEST LINE input from the Transmitter Module. Detector

U2B senses this open circuit and starts C16 discharging. Approximately 0.3 millisecond later, ON-HOOK goes high which resets U26 on the Logic Module to State 1. This completes the SELF-TEST operation.

SECTION 6

MAINTENANCE

6.1 This section provides instructions for maintaining the Identifier at its optimum performance level. Adjustment procedures are provided along with a troubleshooting guide to aid in diagnosing a malfunction to a replaceable module or, in some cases, to a replaceable part.

6.2 When troubleshooting or performing adjustments on the Identifier, the following points should be noted:

■ To prevent possible damage to the Identifier, do not connect either tip or ring of the LINE jack to battery ground.

■ The −48 Vdc battery connected to the BATT jack **is not** switched in the Identifier. It is present on all modules regardless of the position of the POWER switch.

■ When the Identifier attempts an identification, −48 Vdc battery may be applied to tip or ring of the LINE jack. For this reason test equipment connected to the LINE jack must be able to withstand this high dc voltage condition.

■ The chassis of the Identifier is not common to system (battery) ground. For reliable measurements, always use the GND lug on the Power Supply Module as a ground reference.

■ Test points located on the rear of the Identifier are protected from external voltages or ground with 10K ohm resistors. For reliable measurements at these points, use instruments having an input impedance equal to or greater than 1M ohm. A 20K ohm/volt instrument is not adequate.

6.3 TROUBLESHOOTING

6.4 Since most malfunctions are a result of semiconductor failure, it is simplest to handle field problems by parts replacement. Ohmmeter checks are adequate for determining the integrity of diodes and most transistor failures. The large majority of parts used in the Identifier can be purchased locally. All parts used in the Identifier may be purchased from Northeast Electronics.

6.5 In cases where a malfunction cannot be isolated to a particular part, individual modules may be returned to the factory for repair, however, written authorization from Northeast Electronics is required prior to return shipment (Refer to paragraph 3.4).

6.6 Refer to Table 6−1 for overall troubleshooting hints.

6.7 ADJUSTMENTS

6.8 All adjustments are provided on the Identifier's rear panel to allow for convenient calibration. The operating ranges of the unit may be extended or modified with these adjustments. The adjustments and associated test points are accessible from the Identifier rear panels as shown in Figure 3−3. They are summarized below in Table 6−2.

6.9 TEST EQUIPMENT REQUIRED.

6.10 Equipment required to perform the adjustments is listed in Table 6−3. Equivalent test equipment may be used.

6.11 TRANSMIT TONE LEVEL ADJUSTMENT (12KHZ)

1. Connect oscilloscope between TP1 on the Transmitter Module and the GND terminal on the Power Supply Module.

2. Turn-on the Identifier and the oscilloscope.

3. Observe an ac waveform on the oscilloscope and, if necessary, adjust R1 on the Transmitter Module for a 22-volt peak-to-peak amplitude. The waveform dc reference is −48 Vdc.

4. Disconnect oscilloscope from TP1.

6.12 DP DETECTOR RANGE ADJUSTMENT

1. Connect oscilloscope between TP2 on the Transmitter Module and the GND terminal on the Power Supply Module.

NOTE

The TP2 measurement must be made with an instrument having an input impedance of at least 1 megohm.

2. If necessary, adjust R39 on the Transmitter Module for an indication of 1.2 Vdc on the oscilloscope. (cw decreases voltage).

3. Disconnect oscilloscope from TP2.

6.13 "NO DIALING DETECTED" TIMER ADJUSTMENT

1. Connect oscilloscope between TP1 on the Logic Module and the GND terminal on the Power Supply Module.

2. Trigger the oscilloscope internally using the positive-going transition.

3. Set the vertical sensitivity of the oscilloscope to observe +12 Vdc and set time base to 1 sec/div.

4. Depress the SELF-TEST switch on the Identifier while observing the oscilloscope.

5. The trace should go to +12 Vdc for 3 seconds and then return to ground each time a self-test sequence is initiated with the SELF-TEST switch.

6. If necessary, adjust R124 on the Logic Module and repeat steps 4 and 5 until a 3-second delay is observed (cw increases time).

6.14 TT DETECTOR RANGE ADJUSTMENT

1. Connect test equipment as shown in Figure 6–1.

2. Turn-on test equipment and Identifier.

3. Adjust signal generator to 1200 Hz and set output level to −12 dBm as observed on the ac voltmeter (−12 dBm into 600 ohms = 0.19 Vrms).

4. Set oscilloscope to display ±12 Vdc.

5. Adjust R66 on the Transmitter Module clockwise (cw) if TP3 is −12 Vdc or ccw if it is at +12 Vdc. Continue adjustment until TP3 just switches between ±12 Vdc. Set R66 for a continuous +12 Vdc level at TP3.

6. Turn-off test equipment and Identifier.

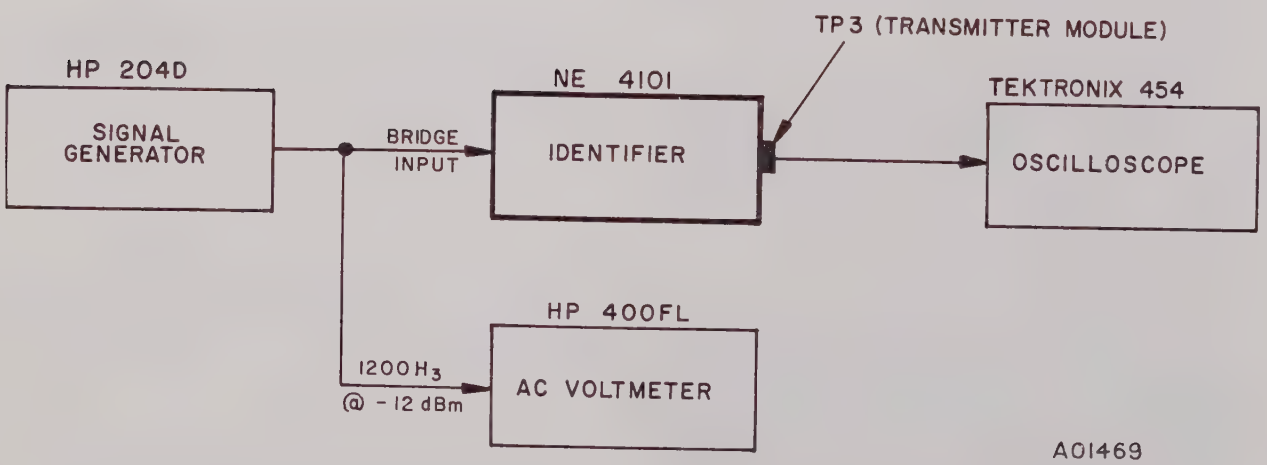


Figure 6–1. TT Sensitivity Test Set-Up

Table 6—1. Troubleshooting Chart

SYMPTOM	POSSIBLE CAUSE	TROUBLESHOOTING CHECKS
1. Display does not light when POWER switch is placed on.	1a. —48 Vdc power not applied to K1 on Power Supply Module.	1a (1) Listen for a relay to energize in area of Power Supply Module when POWER switch is placed on. If a relay can be heard to energize, —48 Vdc power is applied to K1. (2) If the relay does not energize, check —48 Vdc source to BATT jack of Identifier. It must be greater than —42 Vdc. Check that the most negative side goes to the tip. Ground must be connected to the sleeve. The connection to the BATT jack should not be with a transmission-type tensil 310 cord. (3) Check —48 Vdc fuse (.5A) located inside Power Supply Module. (4) Check front panel POWER Switch for open contacts. (5) Check CR13 and K1 on Power Supply Module.
	1b. AC power not applied to Power Supply Module.	1b (1) Observe STATE lamps on rear of Logic Module. If any are lighted, ac power is present. If not lighted, ac power is probably not present at Power Supply Module. (2) Check 115/230 Vac switch position. (3) Check two ac fuses (.3A) on Power Supply Module rear panel. (4) Check ac power source fuse in line of outlet supplying the Identifier. (5) Check for good connection of power cord to Identifier. Check power cord for damage, open-shorted wires etc.

Table 6—1. (Cont'd)

SYMPTOM	POSSIBLE CAUSE	TROUBLESHOOTING CHECKS
	1c. Identifier power supply failure.	1c (1) Monitor TP1 on Transmitter Module. If this voltage is approximately 1 Vdc, the Power Supply Module is probably satisfactory. If the voltage is approximatley −12 Vdc, the +12 Vdc output has probably failed. If the voltage at TP1 is approximately +12 Vdc, the −12 Vdc output has probably failed. (2) Check position of 115/230 Vac switch. (3) Check voltage at pins 21/Y of Power Supply Module for +12 ±.5 Vdc. Check voltage at 8/J for −12 ±.5 Vdc. Check voltage between 18/X (neg) and 19/W (pos) for −5 ±.75 Vdc. (4) Check voltage across C1 and C2 of Power Supply Module for 25 ±10 Vdc. Check voltage across C3 for 15±3 Vdc. (5) Check ac voltage inputs to bridge rectifiers on Power Supply Module to agree with values given on schematic ±10%.
2. Identifier does not perform proper self-test sequence when SELF-TEST button is pressed. NOTE Proper self-test is indicated by the blanking of the front panel display for approximately 3 seconds while the Identifier is in STATE 2, followed by a momentary entry into STATES 3 and 4, and finally returning to STATE 1 while displaying a readout of 8 8 8. The Identifier must be in STATE 1 initially for the self-test command to be recognized.	2a. Identifier does not recognize off-hook (STATE 2) in SELF-TEST mode.	2a (1) Check the STATE lamp status on the Logic Module prior to pressing SELF-TEST button. STATE lamp 1 must be illuminated for recognition of self-test command. (2) Check for a negative voltage of approximately −5.5V dc at TP6 on Transmit Module. If not present, check self-test loading circuit (R30 & R31) on Logic Module. (3) Check that voltage at TP5 on Transmit Module switches from −12 Vdc to +12 Vdc when SELF-TEST button is pressed. If switching occurs, the Logic Module is probably defective.

Table 6—1. (Cont'd)

SYMPTOM	POSSIBLE CAUSE	TROUBLESHOOTING CHECKS
		(4) Observe relay K3 on Transmit Module to see if it energizes when SELF-TEST button is pressed. If it does, the OFF-HOOK detector circuitry on the Transmit Module is probably defective. If it does not, the Logic Module is probably defective.
	2b. Identifier hangs up in state other than STATE 1.	2b (1) Remove any connection made to LINE jack. The Idenfier should return to STATE 1. (2) If the Identifier does not return to STATE 1 check voltage on TP5 of Transmit Module. If the voltage is negative, the Logic Module is probably defective. (3) If the voltage is positive, check relay K3 on the Transmit Module to see if it is deenergized. If it is, the OFF-HOOK detector circuitry is probably defective. If K3 is not energized either K3 or the Logic Module is defective. (4) If the Identifier returns to STATE 1 when the LINE jack connection is removed, the connection is providing a continuous off-hook condition to the Identifier.
3. Identifier gives invalid indication (display decimal points lighted) for all tests.	3a. Transmit signal level too low in amplitude.	3a Check transmit level at TP1 of the Transmit Module. It should be 8Vrms (22 Vac pk-pk). It should be referenced to battery (−48 Vdc) for the standard 4101 or ground for the 4101A. (4101A has the internal strapping arranged for No. 5 X BAR installations).

Table 6—1. (Cont'd)

SYMPTOM	POSSIBLE CAUSE	TROUBLESHOOTING CHECKS
	3b. Valid detector circuitry defective.	3b (1) Check TP2 on Logic Module for a 12 kHz signal switching between +12 volts and ground during STATE 3 of a self-test sequence. Check U25 pin 5 for a 12 kHz signal. If both signals are present, the Logic Module validity detector circuitry is probably defective. (2) If the 12 kHz signal at TP2 is missing, the PAGE SENSE circuitry on the Diode Module is probably defective. (3) If the signal at U25 pin 5 is missing, the Transmit Module 12 kHz oscillator circuitry is probably defective.
4. Identifier transmits identification signal at times other than inter-digital time, wait start dial, or end of TT dialing sequence.	4a. Routiner being used is set to dial outside of the range recognizable by the Identifier.	4a (1) Refer to Figure 2—1 for nominal DP dialing range permitted for use with Identifier. Refer to Figure 2—2 for nominal TT range. Interdigit (ID) time must be set on the Routiner for 400 msec or greater. (2) In cases where less than 400 msec is available for identification at the end of an ac dialing sequence (TT or MF) a wait start dial (WSD) command must be programmed into the Routiner. The WSD must last for at least 400 msec. Refer to Routiner Operator's Manual for information on this function. Failure to use this function when required will result in intermittent or total loss of correct identifications.
	4b. 3 second "No Dialing Detected" timer does not allow sufficient time for digit to be dialed by Routiner.	4b If conditions on the circuits being routined are such that the first dialed digit, or complete digit sequence in the case of ac dialing, does not get outpulsed within a 3 second time limit, extend the 3 second "No Dialing Detected" timer on the Identifier. To do this, follow the instructions in paragraph 6.13 for the 3 second "No Dialing Detected" timer.

Table 6—1 (Cont'd)

SYMPTOM	POSSIBLE CAUSE	TROUBLESHOOTING CHECKS
5. No response to ac dialing (TT or MF).	5a. Pulsing too fast for Identifier recognition.	5a Check Routiner dialing speed and % break for conformance with Figure 2—2.
	5b. TT detector defective.	5b Check voltage at TP3 of Transmit Module. It should be approximately +12 Vdc during ac dialing sequence and fall to approximatley —12 Vdc when dialing sequence completes. If voltages are correct, the Logic Module is probably defective. If they are not correct, the TT detector on the Transmit Module is probably defective.
6. No response to DP dialing.	6a. Pulsing too fast for Identifier recognition.	6a Check Routiner dialing speed and % break for conformance with Figure 2—1.
	6b. DP dialing detector defective.	6b Check voltage at TP5 of Transmit Module. It should be —12 Vdc during dialing and switch to +12 Vdc at the end of each dialed digit. If the voltages are correct, the Logic Module is probably defective. If they are not correct, the Transmit Module is probably defective.

Table 6—2. Adjustments Summary

Test Point	Adjustment	Location	Purpose
TP1	R1	Transmitter Module	Set 12 kHz transmit tone level.
TP2	R39	Transmitter Module	Set DP detector range.
TP3	R66	Transmitter Module	Set TT detector range.
TP1	R124	Logic Module	Set "No dialing Detected" timer.

Table 6—3. Test Equipment Required

Item	Model
AC Voltmeter	HP 400FL
Signal Generator	HP 204D
Oscilloscope	Tektronix 475
Test Cord	Western Electric 310

SECTION 7

DIAGRAMS

7.1 This section contains functional, interconnection, schematic and parts location diagrams for the Identifier.

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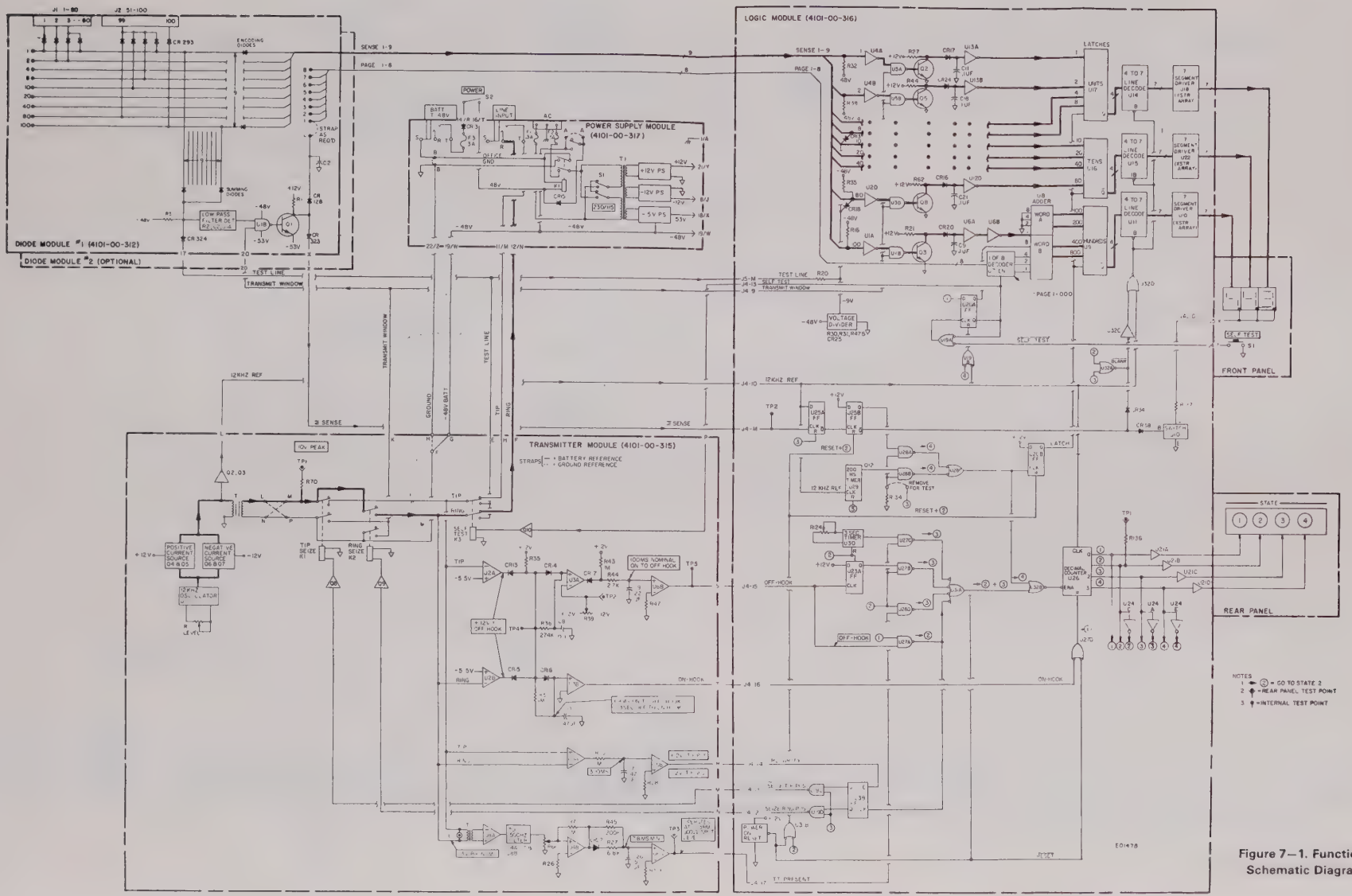


Figure 7–1. Functional Schematic Diagram

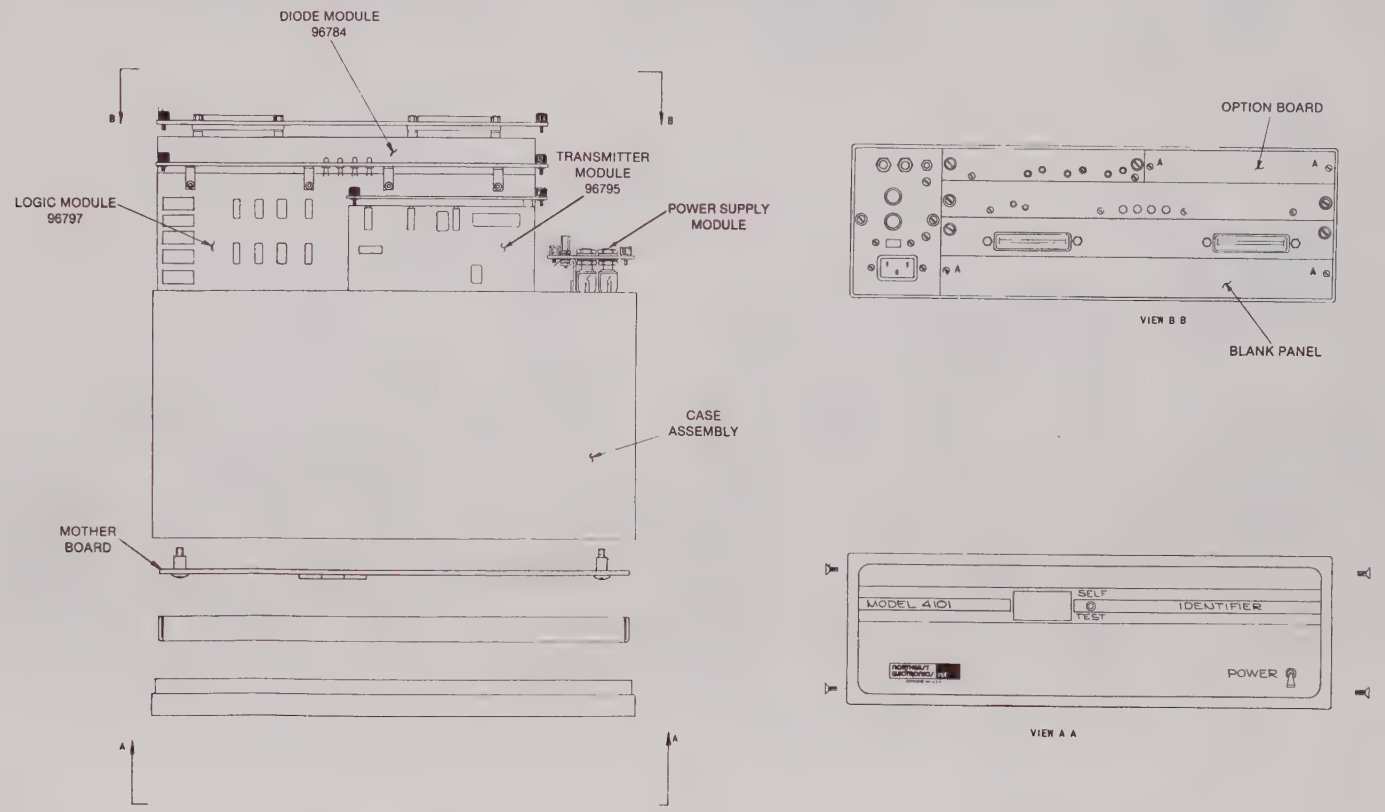


Figure 7—2. Overall Assembly Parts Location Diagram

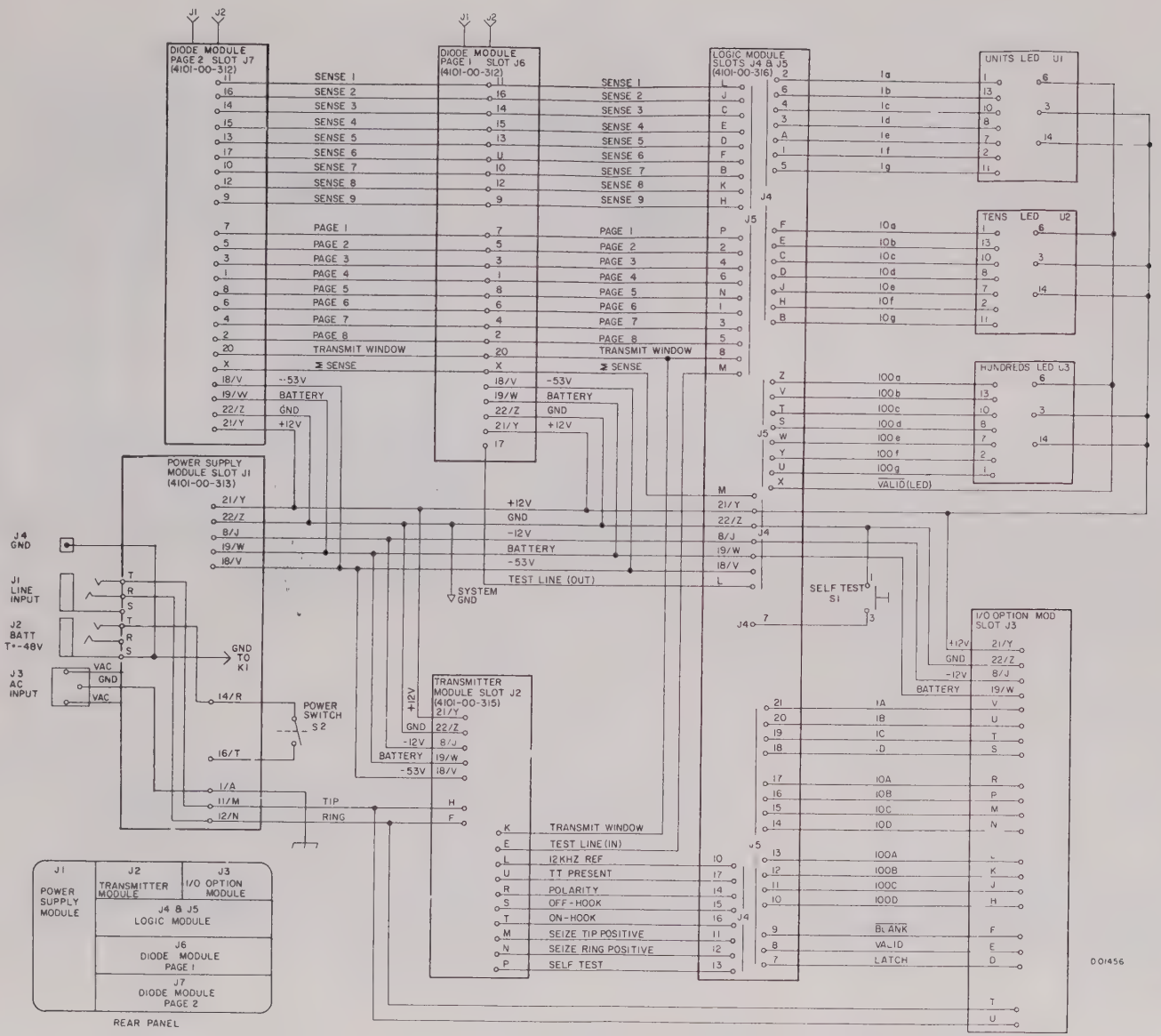


Figure 7—3. Overall Assembly Interconnection Diagram

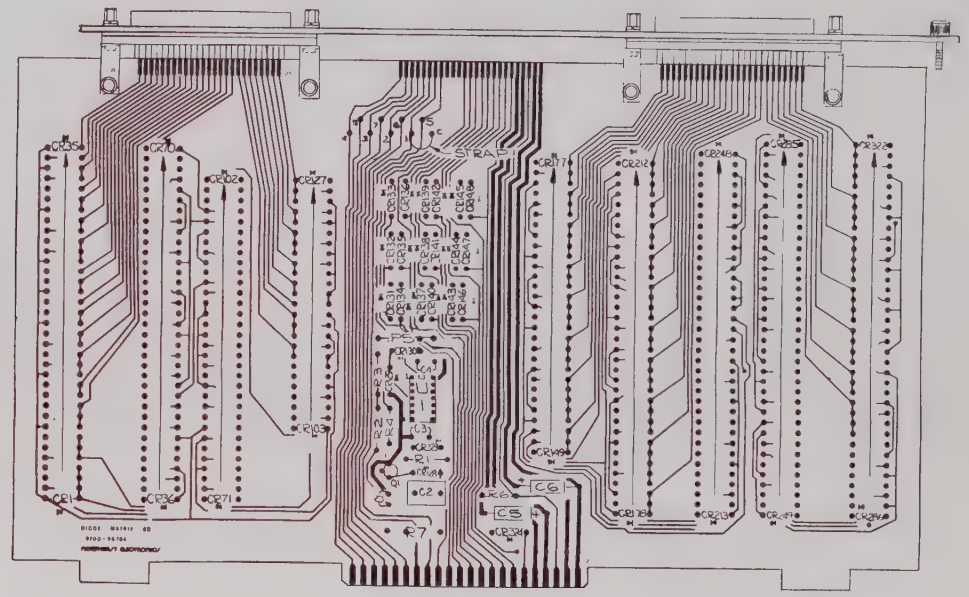


Figure 7—4. Diode Module Parts Location diagram

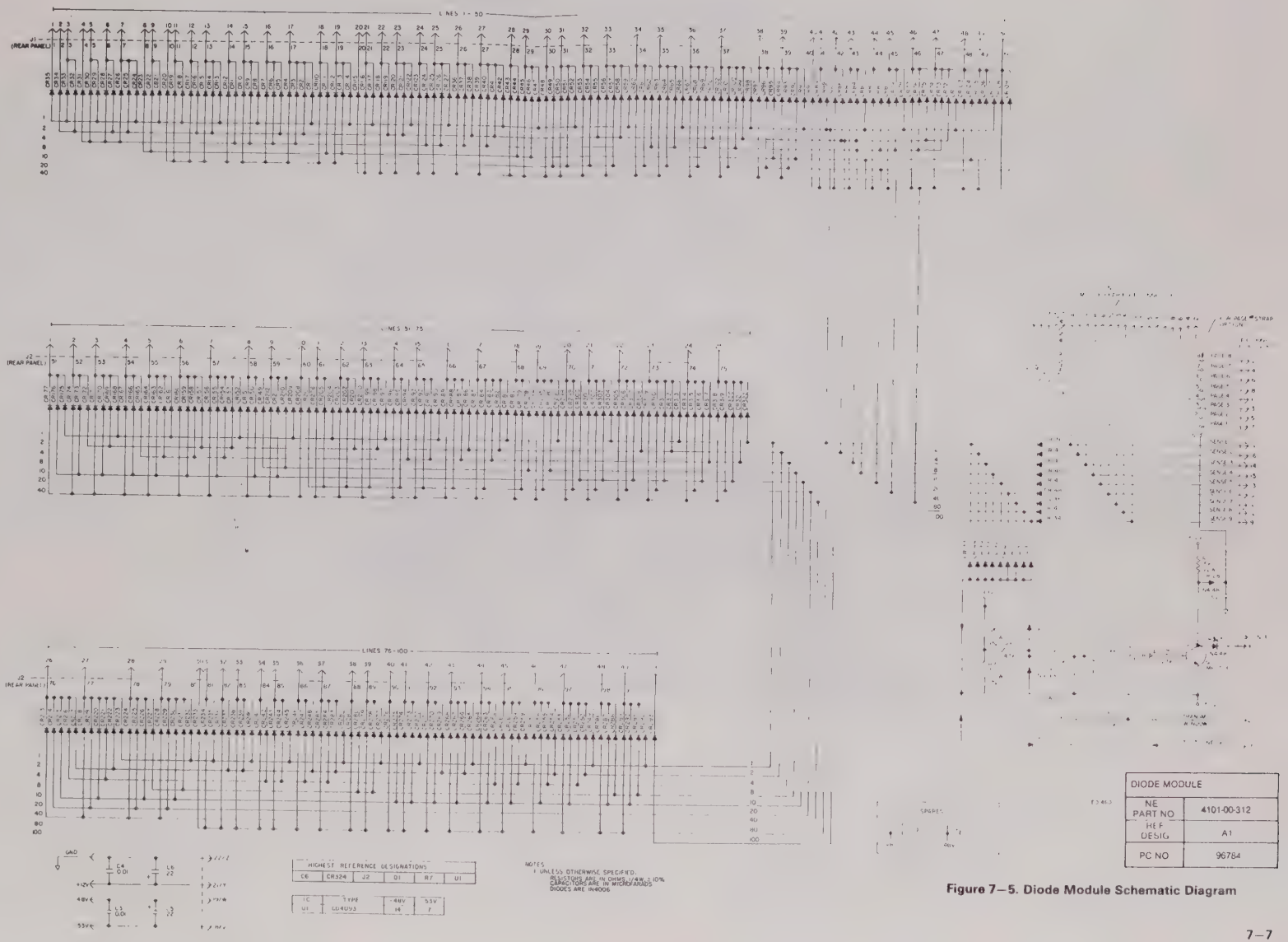


Figure 7–5. Diode Module Schematic Diagram

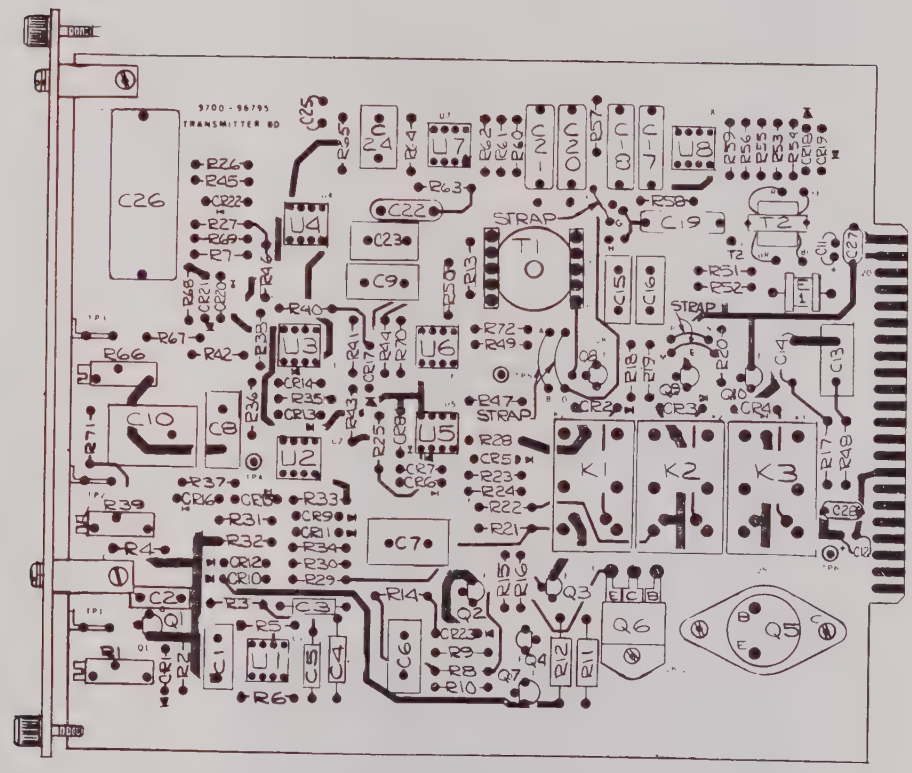
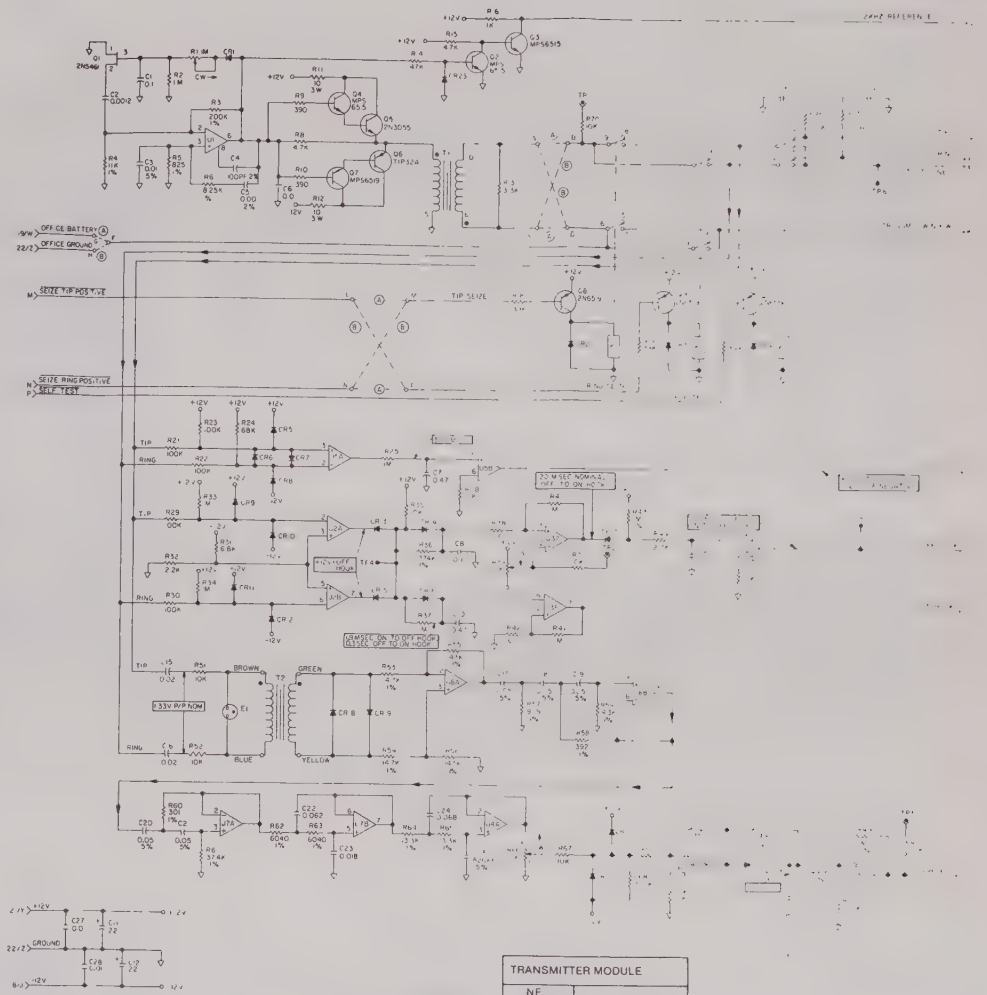


Figure 7—6. Transmitter Module Parts Location Diagram



NOTES
1. UNLESS OTHERWISE SPECIFIED
RESISTORS ARE IN OHMS, 1/4W, ±10%
CAPACITORS ARE IN MICROFARADS
DIODES ARE 1N4148
2. JUMPERS: POSITION (A) FOR BATTERY REFERENCE
POSITION (B) FOR GROUND REFERENCE
3. ◆ = REAR PANEL TEST POINT
4. ◆ = INTERNAL TEST POINT

	TYPE		
J1	NE5517	7	4
J2 - J8	NE5558V	8	4

HIGHEST REFERENCE DESIGNATIONS

U8	C28	CR23	E1	K3	R72	T2	Q0

TRANSMITTER MODULE	
NE PART NO	4101-00-315
REF DESIG	A2
PC NO	96795

Figure 7—7. Transmitter Module Schematic Diagram

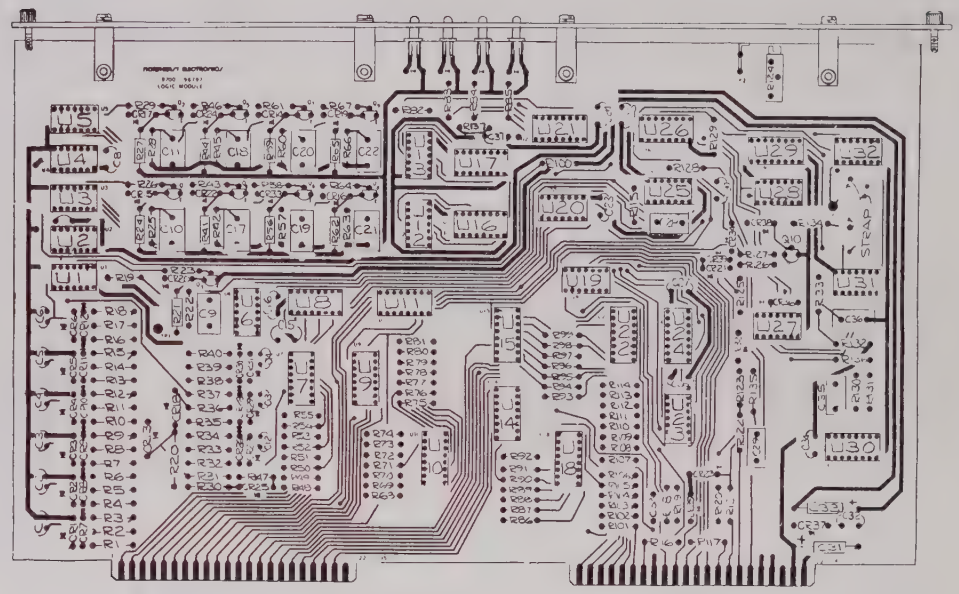
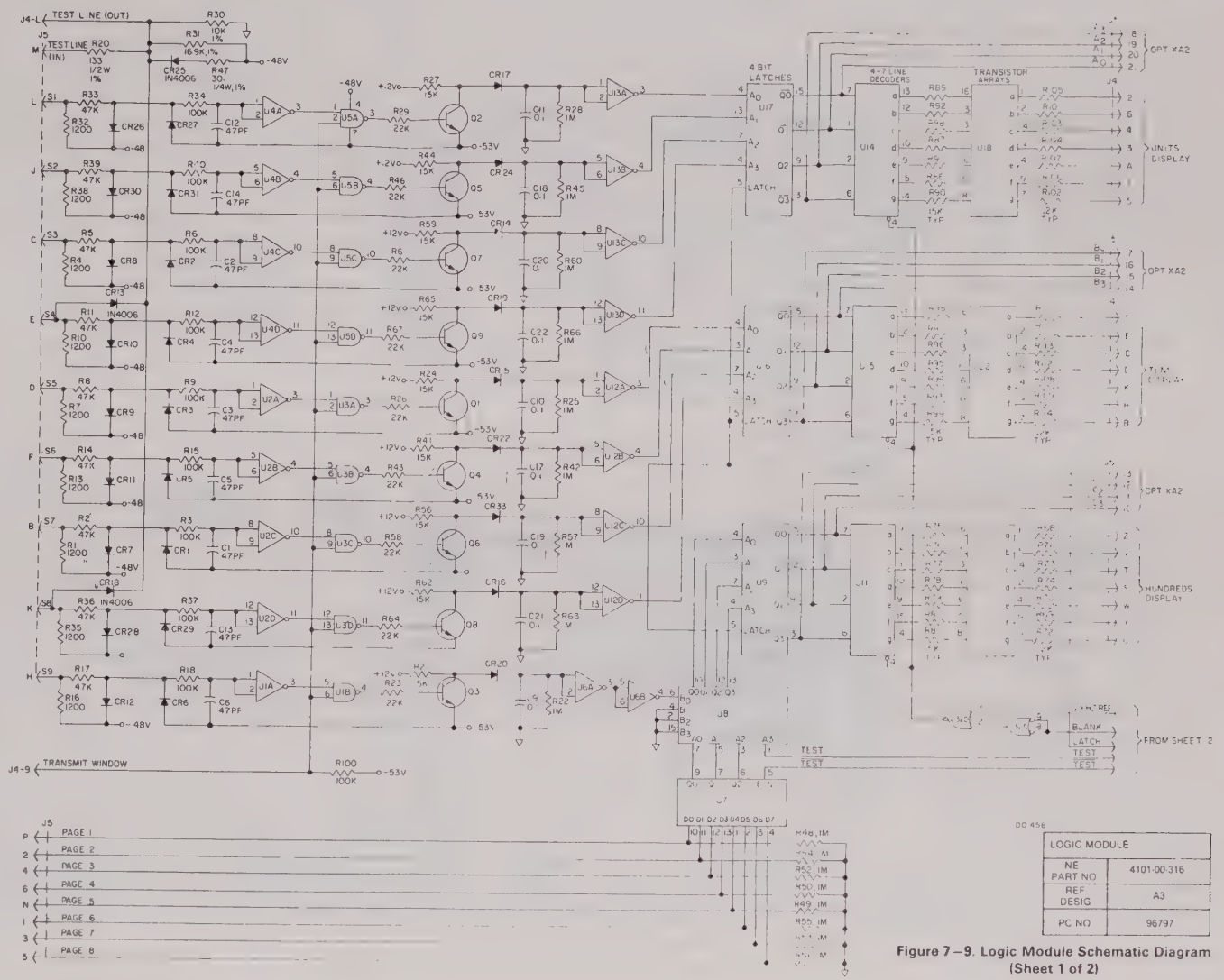
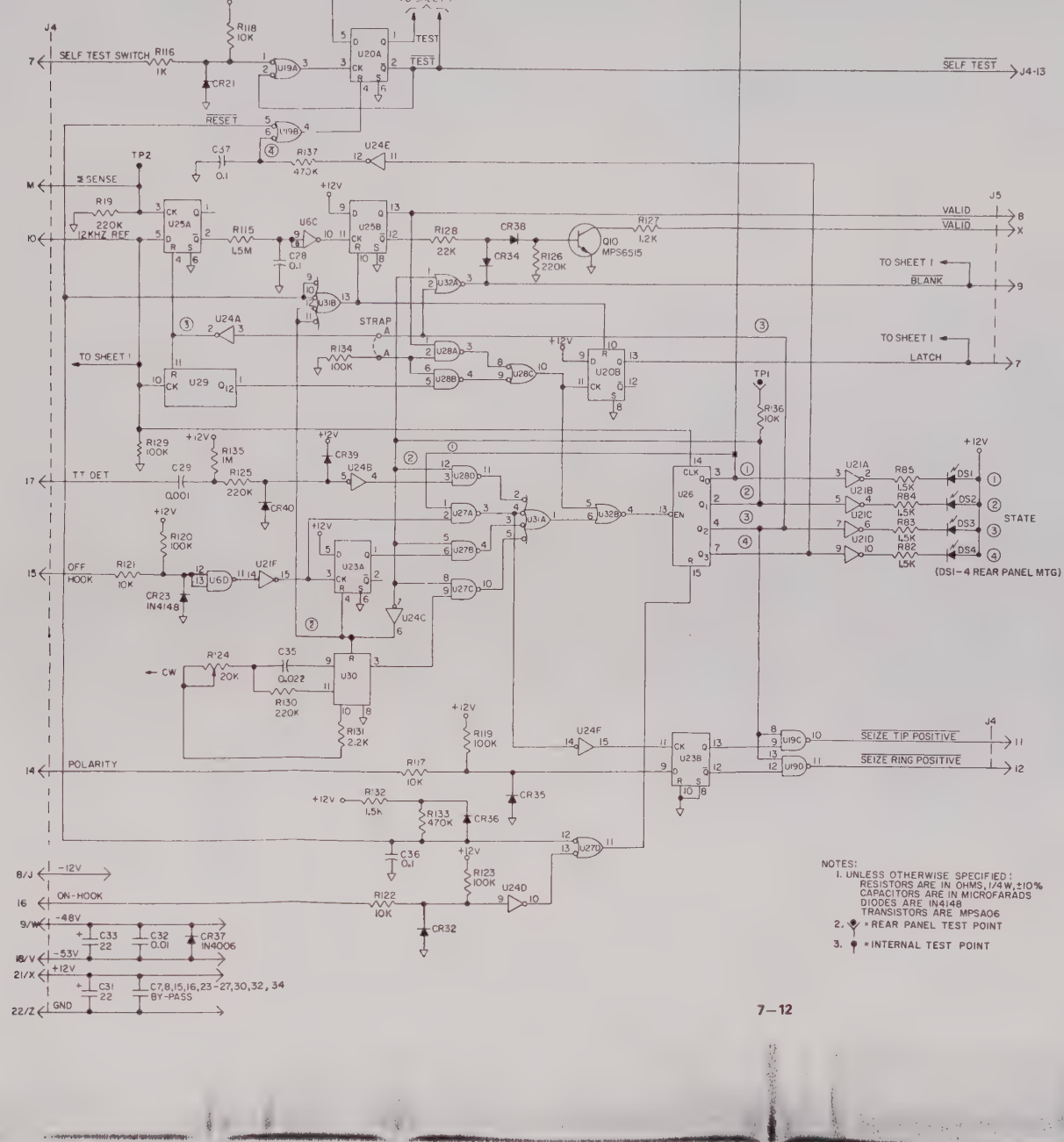


Figure 7—8. Logic Module Parts Location Diagram



LOGIC MODULE	
NE PART NO	4101-00-316
REF DESIG	A3
PC NO	96797

Figure 7–9. Logic Module Schematic Diagram (Sheet 1 of 2)



I C	TYPE	+12V	GND	-48V	-53V
U20,23,25	CD40 3	14	7	—	—
U29	CD4020	16	8	—	—
U26	CD4017	16	8	—	—
U30	CD4060	16	8	—	—
U3,5	CD4011	—	—	14	7
U19,27,28	CD4011	14	7	—	—
U32	CD4001	14	7	—	—
U31	CD4012	4	7	—	—
U24,21	CD4049	1	8	—	—
U8	CD4008	16	8	—	—
U9,16,17	CD4042	16	8	—	—
U1,2,4	CD4093	—	—	14	7
U6,12,13	CD4093	14	7	—	—
U11,14,15	CD4511	16	8	—	—
U10,18,22	CA3081	—	5,15	—	—
U7	CD4532	16	8	—	—

HIGHEST REF DES				
CR40	Q10	R137	U32	C37

D01457

NOTES:
1. UNLESS OTHERWISE SPECIFIED:
   RESISTORS ARE IN OHMS, 1/4W, ±10%
   CAPACITORS ARE IN MICROFARADS
   DIODES ARE IN4148
   TRANSISTORS ARE MPSA06
2. ◆ = REAR PANEL TEST POINT
3. ● = INTERNAL TEST POINT

Figure 7–9. Logic Module Schematic Diagram (Sheet 2 of 2)

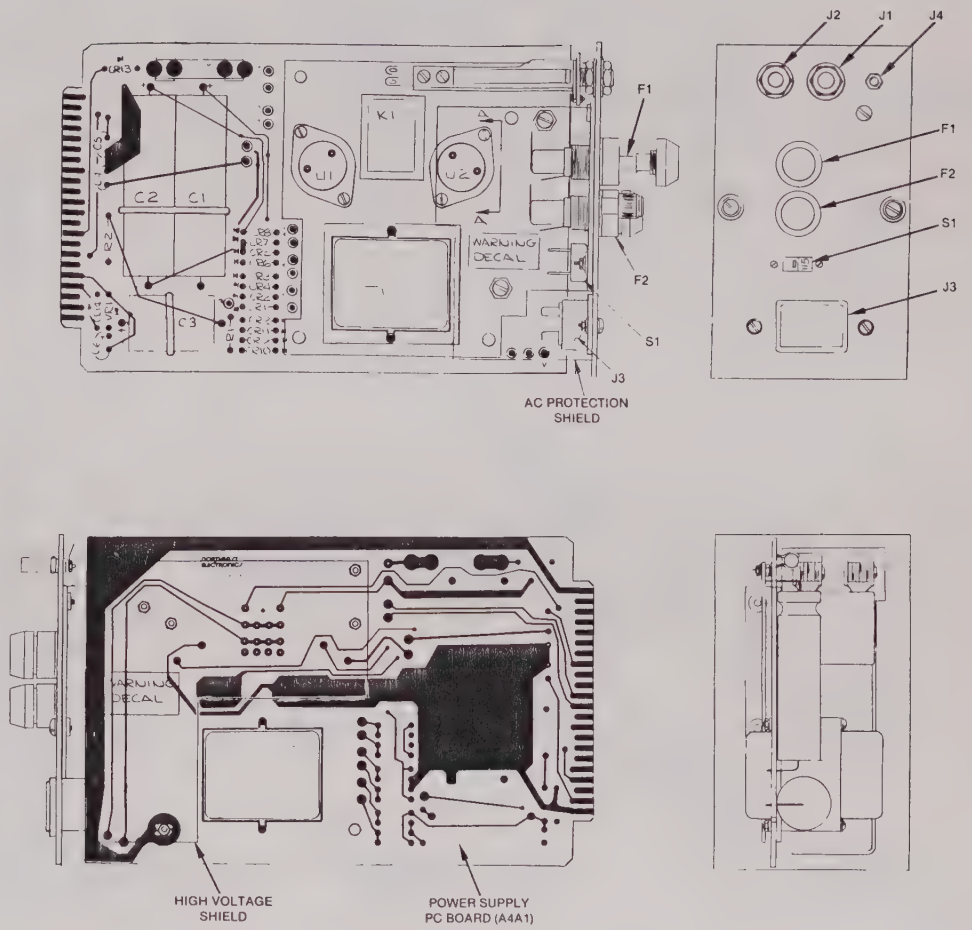
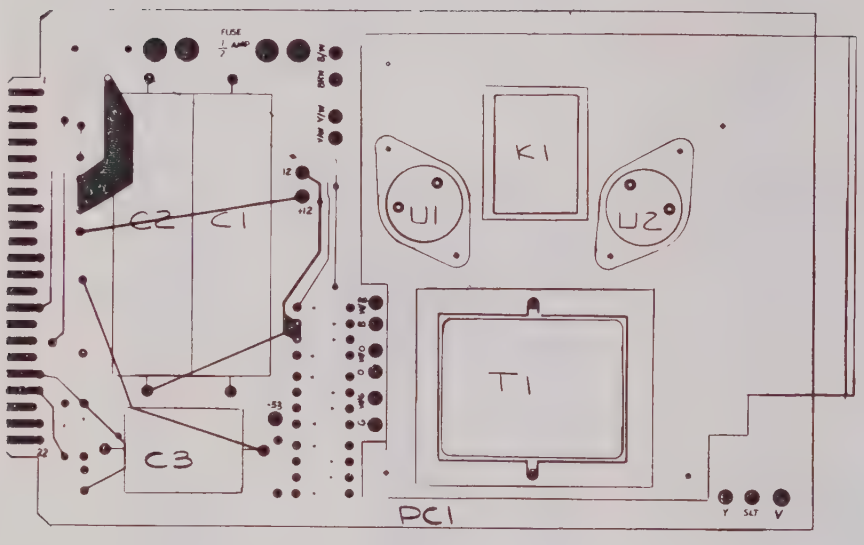
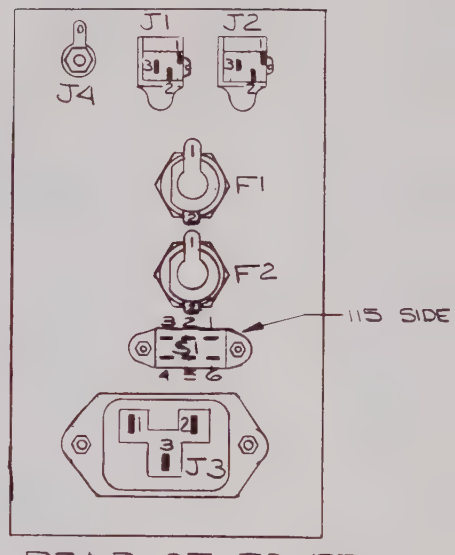


Figure 7—10. Power Supply Module Parts Location Diagram





REAR OF POWER SUPPLY PANEL

WIRE LIST		
T1	BLACK	S1-5
PC1-BRN	BRN	J1-1
T1	RED	S1-6
T1	ORANGE	PC-0
PC1-Y	YELLOW	J3-3
T1	GREEN	PC1-G
T1	BLUE	PC1-B
PC1-V	VIOLET	S1-6
PC1-SL	SLATE	F1-2
T1	WHITE	J3-3
T1	WH/BLK	S1-1
PC1-B/W	WH/BRN	J1-3
T1	WH/RED	S1-2
T1	WH/OR	PC1 W/O
PC1-Y/W	WH/YEL	J2-3
T1	WH/GRN	PC1-W/G
T1	WH/BLU	PC1-WH/BU
PC1-V/W	WH/VIO	J2-2
J3-1	STRAP	F1-1
J3-2	STRAP	F2-1
S1-1	STRAP	F2-2
S1-3	STRAP	S1-4
J4	STRAP	J1-1

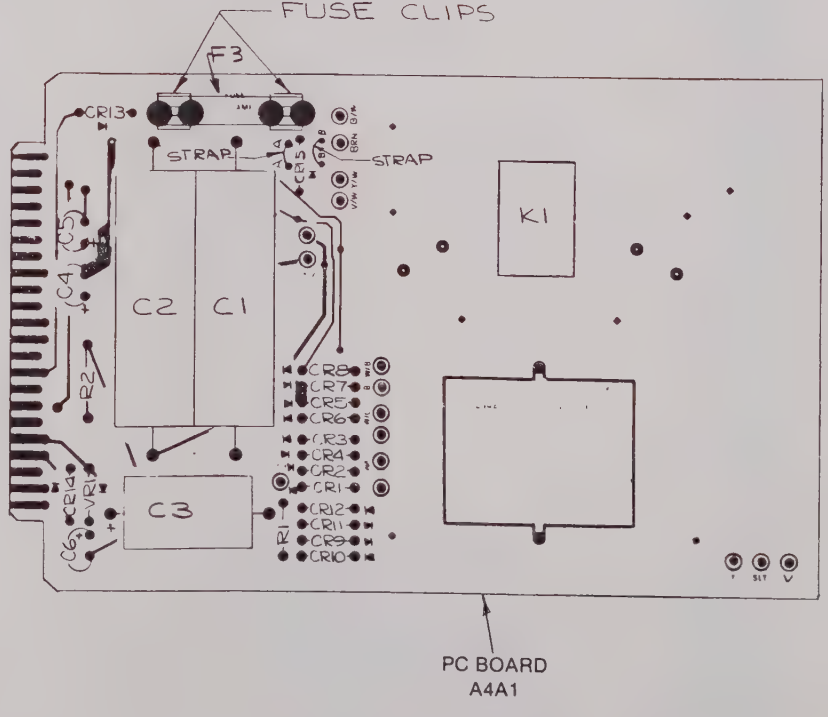
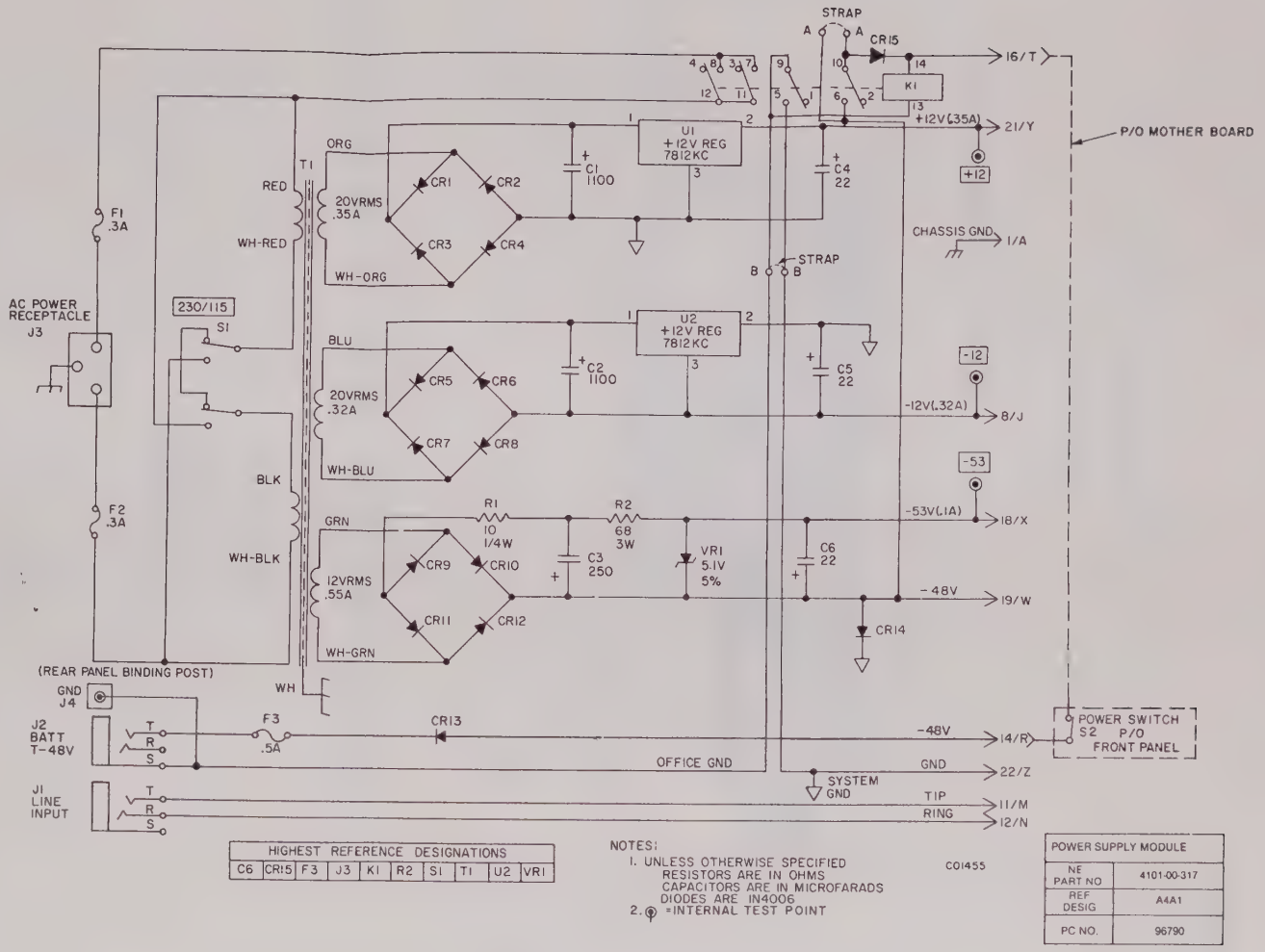


Figure 7—11. Power Supply PC Board Parts Location Diagram



HIGHEST REFERENCE DESIGNATIONS									
C6	CR15	F3	J3	K1	R2	S1	T1	U2	VR1

NOTES:
1. UNLESS OTHERWISE SPECIFIED
   RESISTORS ARE IN OHMS
   CAPACITORS ARE IN MICROFARADS
   DIODES ARE IN4006
2. ⊕ =INTERNAL TEST POINT

C01455

POWER SUPPLY MODULE	
NE PART NO	4101-00-317
REF DESIG	A4A1
PC NO.	96790

Figure 7—12. Power Supply Module Schematic Diagram

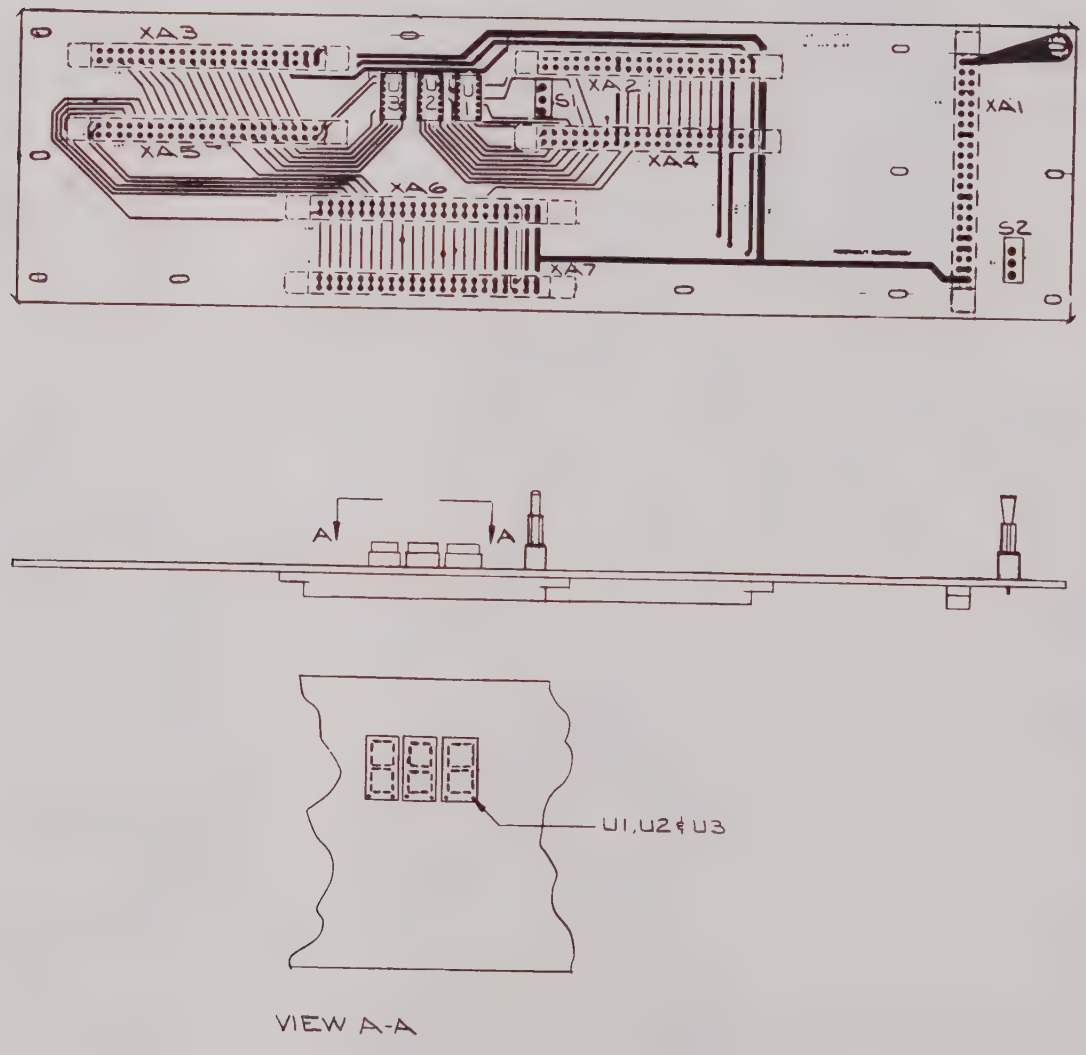


Figure 7—13. Mother Board Parts Location Diagram

SECTION 8

PARTS LIST

8.1 This section contains parts lists for the Identifier.

Table 8—1. Overall Assembly 4101 Parts List

REFERENCE DESIGNATOR	DESCRIPTION VALUE	POWER	TOL	VOLTS	MFGR.	MFGR. PART NO.	N.E.C. PART NO.
A1	ASSY 96784 DIODE MODULE						A410100012
A2	ASSY 96795 XMIT MODULE						A410100015
A3	ASSY 96797 LOGIC MODULE						A410100016
A4	POWER SUPPLY MODULE						A410100017
A5	ASSY 96791 MOTHER BOARD						A410100014
	FOOT,RUBBER,SM.FEM.MTG				AIR	1322CW	836500300
	HANDLE CASE 5-1/3 IN BLK				PHC	1879-376-370	856100100
	CONNECTIC, CABLE						C410100010
	RACK BRKT DETAIL						C410100124
	PWR.CORD,7-1/2' YEL.3COND 16				BELDEN	Y-LLCC 17250	830000801
	BUTTON CAP FOR 8125 SWITC				C+P	8125-2 GRAY	6102011?2

Table 8—2. Diode Module 96784 (A1) Parts List

REFERENCE DESIGNATOR	DESCRIPTION VALUE	POWER	TOL	VOLTS	MFGR.	MFGR. PART NO.	N.E.C. PART NO.
C1	47PF		5%	100V	ELMENCO	CM04-A470J0-	335404700
C2	.1UF		10%	100V	SPRAGUE	225P10491WD3	320001040
C3-4	.01UF		20%	16V	CENTRALAB	UK16-103	330701031
C5-6	22UF		10%	15V	SPRAGUE	150D226X9015B2	310302260
CR1-128	D041	1A SI		800V	EDAL	1N4006	560040060
CR129-130	D035 4NS 10MA SI			50UA	FAIRCHILD	1N4148	560041480
CR131-322	D041	1A SI		800V	EDAL	1N4006	560040060
CR323	D035 4NS 10MA SI			50UA	FAIRCHILD	1N4148	560041480
CR324	D041	1A SI		800V	EDAL	1N4006	560040060
J1	CONN,50PIN CHAMP,EDGE MTG				AMP	552130-1	654002800
J2	CONN,50PIN CHAMP,EDGE MTG				AMP	552130-1	654002800
Q1	TO-92 625MW TA NPN			80V	MOTOROLA	MPS-A06	550000060
R1	15K	1/2W	5%		AB	TYPE EB	200201535
R2	100K	1/2W	10%		AB	TYPE EB	200201046
R3	47K	1/2W	10%		AB	TYPE EB	200204736
R4	27K	1/4W	10%		AB	TYPE CB	200102736
R5	953-	1/2W	1%		ELECTRA	RN65 SIZE 100 PPM	220695301
R6	100K	1/4W	10%		AB	TYPE CB	200101046
R7	301-	1/2W	1%		ELECTRA	RN65 SIZE 100 PPM	220630101
U1	14DIP-P	B		CMOS	RCA	CD4093	510004093

Table 8—3. Transmitter Module 96795 (A2) Parts List

REFERENCE DESIGNATOR	DESCRIPTION VALUE	POWER	TOL	VOLTS	MFGR.	MFGR. PART NO.	N.E.C. PART NO.
C1	.1UF		10%	100V	SPRAGUE	225P10491WD3	320001040
C2	.0012UF		10%	100V	SPRAGUE	225P12291WD3	320001220
C3	.01UF		5%	100V	F-DYNE	PS11-.01-100-5	321501070
C4	100PF		2%	500V	ARCO	CM04FD101G0	335401010
C5	1000PF		2%	100V	ELMENCO	CM06CA102G0	335401020
C6	.01UF		10%	100V	SPRAGUE	225P10391WD3	320001070
C7	.47UF		10%	100V	SPRAGUE	225P47491XD3	320004740
C8	.1UF		10%	100V	SPRAGUE	225P10491WD3	320001040
C9	.22UF		10%	100V	SPRAGUE	225P22491XD3	320002240
C10	.47UF		10%	100V	SPRAGUE	225P47491XD3	320004740
C11-12	22UF		10%	15V	KEMET	T330C226K015AS	310002261
C13-14	.1UF		10%	100V	SPRAGUE	225P10491WD3	320001040
C15-16	.02UF		10%	100V	SPRAGUE	225P20391WD3	320002030
C17-21	.05UF		5%	100V	ELMENCO	1MD-2-503J	322005030
C22	.062UF		10%	100V	ELMENCO	1MDF-2-623	322006230
C23	.018UF		10%	100V	SPRAGUE	225P18391WD3	320001830
C24	.068UF		10%	100V	SPRAGUE	225P68391WD3	320006830
C25	820 PF		5%	300V	ELMENCO	CM05-C821JO	335408210
C26	.50UF		10%	100V	SPRAGUE	225P50491YD3	320005040
C27-28	.01UF		20%	16V	CENTRALAB	UK16-103	330701031
CR1-23	DO35 4NS 10MA		SI	50UA	FAIRCHILD	1N4148	560041480
E1	PROTECTOR S/V GAS				SIEMENS	B1-C90/20	566009020
K1-3	RELAY,PC,DPDT,LOW PROF.				SIEMENS	V23012-A0102-B001	604600500
G1	TO92 310MW TA		P	40V	MOTOROLA	MPF152 2N5461	555001520
G2-4	TO-92 350MW TA		NPN	25V	MOTOROLA	MPS6515	550065154
G5	TO-3 115W TC		NPN	60V	RCA	2N3055	550030550
G6	MODTO220 40W TC		PNP	60V	TI	TIP32A	552000321
G7-10	TO92 350MW TC		PNP	25V	MOTOROLA	MPS6519	552065190
R1	1MEG	.75W	10%		HELIPOT	89PR1M	232501050
R2	1M	1/4W	10%		AB	TYPE CB	200101054
R3	200K	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220220031
R4	11K	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220211021
R5	825-	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220282501
R6	8250-	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220282511
R7	1M	1/4W	10%		AB	TYPE CB	200101054
R8	4.7K	1/4W	10%		AB	TYPE CB	200104726
R9-10	390-	1/4W	10%		AB	TYPE CB	200103916
R11-12	10-	3W	5%		W LEONARD	TYPE 3X	210301005
R13	3.3K	1/4W	10%		AB	TYPE CB	200103326
R14	47K	1/4W	10%		AB	TYPE CB	200104736
R15	4.7K	1/4W	10%		AB	TYPE CB	200104726
R16	1K	1/4W	10%		AB	TYPE CB	200101024
R17	1.2K	1/2W	10%		AB	TYPE EB	200201226
R18-20	39K	1/4W	10%		AB	TYPE CB	200103936
R21-23	100K	1/4W	10%		AB	TYPE CB	200101044
R24	68K	1/4W	10%		AB	TYPE CB	200106836
R25	1M	1/4W	10%		AB	TYPE CB	200101056
R26	10K	1/4W	10%		AB	TYPE CB	200101036

Table 8—3 (Cont'd)

REFERENCE DESIGNATOR	DESCRIPTION VALUE	POWER	TOL	VOLTS	MFGR.	MFGR. PART NO.	N.E.C. PART NO.
R27	2210-	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220222111
R28	10K	1/4W	10%		AB	TYPE CB	200101036
R29-30	100K	1/4W	10%		AB	TYPE CB	200101046
R31	6.8K	1/4W	10%		AB	TYPE CB	200106826
R32	2.2K	1/4W	10%		AB	TYPE CB	200102226
R33-34	1M	1/4W	10%		AB	TYPE CB	200101056
R35	10K	1/4W	10%		AB	TYPE CB	200101036
R36	274K	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220227431
R37	1M	1/4W	10%		AB	TYPE CB	200101056
R38	100-	1/4W	10%		AB	TYPE CB	200101016
R39	10K	.75W	10%		HELIPOT	89PR10K	232501030
R40-41	1M	1/4W	10%		AB	TYPE CB	200101056
R42	100-	1/4W	10%		AB	TYPE CB	200101016
R43	1M	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220210041
R44	2.7K	1/4W	10%		AB	TYPE CB	200102726
R45	274K	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220227431
R46	499K	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220249931
R47	10K	1/4W	10%		AB	TYPE CB	200101036
R48	1.2K	1/2W	10%		AB	TYPE EB	200201226
R49	1M	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220210041
R50	270K	1/4W	10%		AB	TYPE CB	200102746
R51-52	10K	1/4W	10%		AB	TYPE CB	200101036
R53-54	14.7K	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220214721
R55-56	147K	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220214731
R57	909-	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220290901
R58	392-	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220239201
R59	14.3K	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220214321
R60	301-	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220230101
R61	37.4K	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220237421
R62-63	6040-	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220260411
R64-65	13.3K	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220213321
R66	10K	.75W	10%		HELIPOT	89PR10K	232501030
R67	10K	1/4W	10%		AB	TYPE CB	200101036
R68	220K	1/4W	10%		AB	TYPE CB	200102246
R69	100-	1/4W	10%		AB	TYPE CB	200101016
R70-72	10K	1/4W	10%		AB	TYPE CB	200101036
T1	TRANSFORMER,POT CORE				MIDCOM	671-5012	420900105
T2	XFMR PC AUDIO 50KCT/50KCT				MICROT	VM15-EPB	400101100
TP1-3	TERM.,TEST POINT				N.T.I.	P0508551	652900400
U1	8PDIL			22V	SIGNETICS	NE531	500005310
U2-8	8PDIL	80MW		18V	SIGNETICS	N5558V	500055580

Table 8—4. Logic Module 96797 (A3) Parts List

REFERENCE DESIGNATOR	DESCRIPTION VALUE	POWER	TOL	VOLTS	MFGR.	MFGR. PART NO.	N.E.C. PART NO.
C1-6	47PF		5%	100V	ELMENCO	CM04-A470J0-	335404700
C7-8	.01UF		20%	16V	CENTRALAB	UK16-103	330701031
C9-11	.1UF		10%	100V	SPRAGUE	225P10491WD3	320001040
C12-14	47PF		5%	100V	ELMENCO	CM04-A470J0-	335404700
C15-16	.01UF		20%	16V	CENTRALAB	UK16-103	330701031
C17-22	.1UF		10%	100V	SPRAGUE	225P10491WD3	320001040
C23-27	.01UF		20%	16V	CENTRALAB	UK16-103	330701031
C28	.1UF		10%	100V	SPRAGUE	225P10491WD3	320001040
C29	.001UF		10%	100V	SPRAGUE	225P10291WD3	320001020
C30	.01UF		20%	16V	CENTRALAB	UK16-103	330701031
C31	22UF		10%	15V	SPRAGUE	150D226X9015B2	310302260
C32	.01UF		20%	16V	CENTRALAB	UK16-103	330701031
C33	22UF		10%	15V	SPRAGUE	150D226X9015B2	310302260
C34	.01UF		20%	16V	CENTRALAB	UK16-103	330701031
C35	.022UF		10%	100V	SPRAGUE	225P22391WD3	320002230
C36-37	.1UF		10%	100V	SPRAGUE	225P10491WD3	320001040
C38	.01UF		20%	16V	CENTRALAB	UK16-103	330701031
CR1-12	DO35 4NS 10MA		SI	50UA	FAIRCHILD	1N4148	560041480
CR13-20	DO41	1A	SI	800V	EDAL	1N4006	560040060
CR21	DO35 4NS 10MA		SI	50UA	FAIRCHILD	1N4148	560041480
CR22	DO41	1A	SI	800V	EDAL	1N4006	560040060
CR23	DO35 4NS 10MA		SI	50UA	FAIRCHILD	1N4148	560041480
CR24-25	DO41	1A	SI	800V	EDAL	1N4006	560040060
CR26-32	DO35 4NS 10MA		SI	50UA	FAIRCHILD	1N4148	560041480
CR33	DO41	1A	SI	800V	EDAL	1N4006	560040060
CR34	DO35 4NS 10MA		SI	50UA	FAIRCHILD	1N4148	560041480
CR35-36	DO35 4NS 10MA		SI	50UA	FAIRCHILD	1N4148	560041480
CR37	DO41	1A	SI	800V	EDAL	1N4006	560040060
CR38-39	DO35 4NS 10MA		SI	50UA	FAIRCHILD	1N4148	560041480
DS1-4	LED,RED DIFF,PANEL				MONSANTO	MV5023	564500900
G1-9	TO-92 625MW TA NPN			80V	MOTOROLA	MPS-A06	550000060
G10	TO-92 350MW TA NPN			25V	MOTOROLA	MPS6515	550065150
R1	1.2K	1/2W 10%			AB	TYPE EB	200201226
R2	47K	1/2W 10%			AB	TYPE EB	200204736
R3	100K	1/2W 10%			AB	TYPE EB	200201046
R4	1.2K	1/2W 10%			AB	TYPE EB	200201226
R5	47K	1/2W 10%			AB	TYPE EB	200204736
R6	100K	1/2W 10%			AB	TYPE EB	200201046
R7	1.2K	1/2W 10%			AB	TYPE EB	200201226
R8	47K	1/2W 10%			AB	TYPE EB	200204736
R9	100K	1/2W 10%			AB	TYPE EB	200201046
R10	1.2K	1/2W 10%			AB	TYPE EB	200201226
R11	47K	1/2W 10%			AB	TYPE EB	200204736
R12	100K	1/2W 10%			AB	TYPE EB	200201046
R13	1.2K	1/2W 10%			AB	TYPE EB	200201226
R14	47K	1/2W 10%			AB	TYPE EB	200204736
R15	100K	1/2W 10%			AB	TYPE EB	200201046
R16	1.2K	1/2W 10%			AB	TYPE EB	200201226
R17	47K	1/2W 10%			AB	TYPE EB	200204736
R18	100K	1/2W 10%			AB	TYPE EB	200201046

Table 8—4. (Cont'd)

REFERENCE DESIGNATOR	DESCRIPTION VALUE	POWER	TOL	VOLTS	MFGR.	MFGR. PART NO.	N.E.C. PART NO.
R19	220K	1/4W	10%		AB	TYPE CB	200102246
R20	133-	1/2W	1%		ELECTRA	RN65 SIZE 100 PPM	220613301
R21	15K	1/2W	5%		AB	TYPE EB	200201535
R22	1M	1/4W	10%		AB	TYPE CB	200101056
R23	22K	1/4W	10%		AB	TYPE CB	200102236
R24	15K	1/2W	5%		AB	TYPE EB	200201535
R25	1M	1/4W	10%		AB	TYPE CB	200101056
R26	22K	1/4W	10%		AB	TYPE CB	200102236
R27	15K	1/2W	5%		AB	TYPE EB	200201535
R28	1M	1/4W	10%		AB	TYPE CB	200101056
R29	22K	1/4W	10%		AB	TYPE CB	200102236
R30	10K	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220210021
R31	16.9K	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220216921
R32	1.2K	1/2W	10%		AB	TYPE EB	200201226
R33	47K	1/2W	10%		AB	TYPE EB	200204736
R34	100K	1/2W	10%		AB	TYPE EB	200201046
R35	1.2K	1/2W	10%		AB	TYPE EB	200201226
R36	47K	1/2W	10%		AB	TYPE EB	200204736
R37	100K	1/2W	10%		AB	TYPE EB	200201046
R38	1.2K	1/2W	10%		AB	TYPE EB	200201226
R39	47K	1/2W	10%		AB	TYPE EB	200204736
R40	100K	1/2W	10%		AB	TYPE EB	200201046
R41	15K	1/2W	5%		AB	TYPE EB	200201535
R42	1M	1/4W	10%		AB	TYPE CB	200101056
R43	22K	1/4W	10%		AB	TYPE CB	200102236
R44	15K	1/2W	5%		AB	TYPE EB	200201535
R45	1M	1/4W	10%		AB	TYPE CB	200101056
R46	22K	1/4W	10%		AB	TYPE CB	200102236
R47	301-	1/4W	1%		ELECTRA	RN60 SIZE 100 PPM	220530101
R48-49	1M	1/4W	10%		AB	TYPE CB	200101056
R50-55	1M	1/4W	10%		AB	TYPE CB	200101056
R56	15K	1/2W	5%		AB	TYPE EB	200201535
R57	1M	1/4W	10%		AB	TYPE CB	200101056
R58	22K	1/4W	10%		AB	TYPE CB	200102236
R59	15K	1/2W	5%		AB	TYPE EB	200201535
R60	1M	1/4W	10%		AB	TYPE CB	200101056
R61	22K	1/4W	10%		AB	TYPE CB	200102236
R62	15K	1/2W	5%		AB	TYPE EB	200201535
R63	1M	1/4W	10%		AB	TYPE CB	200101056
R64	22K	1/4W	10%		AB	TYPE CB	200102236
R65	15K	1/2W	5%		AB	TYPE EB	200201535
R66	1M	1/4W	10%		AB	TYPE CB	200101056
R67	22K	1/4W	10%		AB	TYPE CB	200102236
R68-74	1.2K	1/4W	10%		AB	TYPE CB	200101226
R75-81	15K	1/4W	10%		AB	TYPE CB	200101536

Table 8—4. (Cont'd)

REFERENCE DESIGNATOR	DESCRIPTION VALUE	POWER	TOL	VOLTS	MFGR.	MFGR. PART NO.	N.E.C. PART NO.
R82-85	1.5K	1/4W	10%		AB	TYPE CB	200101526
R86-99	15K	1/4W	10%		AB	TYPE CB	200101536
R100	100K	1/4W	10%		AB	TYPE CB	200101046
R101-114	1.2K	1/4W	10%		AB	TYPE CB	200101226
R115	1.5M	1/4W	10%		AB	TYPE CB	200101556
R116	1K	1/4W	10%		AB	TYPE CB	200101026
R117-118	10K	1/4W	10%		AB	TYPE CB	200101036
R119-120	100K	1/4W	10%		AB	TYPE CB	200101046
R121-122	10K	1/4W	10%		AB	TYPE CB	200101036
R123	100K	1/4W	10%		AB	TYPE CB	200101046
R124	20K	.75W	10%		HELIPOT	89PR20K	232502030
R125-126	220K	1/4W	10%		AB	TYPE CB	200102246
R127	1.2K	1/4W	10%		AB	TYPE CB	200101226
R128	22K	1/4W	10%		AB	TYPE CB	200102236
R129	100K	1/4W	10%		AB	TYPE CB	200101046
R130	220K	1/4W	10%		AB	TYPE CB	200102246
R131	2.2K	1/4W	10%		AB	TYPE CB	200102226
R132	1.5K	1/4W	10%		AB	TYPE CB	200101526
R133	470K	1/4W	10%		AB	TYPE CB	200104746
R134	100K	1/4W	10%		AB	TYPE CB	200101046
R135	1M	1/4W	10%		AB	TYPE CB	200101056
R136	10K	1/4W	10%		AB	TYPE CB	200101036
R137	470K	1/4W	10%		AB	TYPE CB	200104746
TP1	TERM.,TEST POINT				N.T.I.	P0508551	652900400
U1-2	14DIP-P	B		CMOS	RCA	CD4093	510004093
U3	14DIP-P	B/UB		CMOS	RCA	CD4011	510004011
U4	14DIP-P	B		CMOS	RCA	CD4093	510004093
U5	14DIP-P	B/UB		CMOS	RCA	CD4011	510004011
U6	14DIP-P	B		CMOS	RCA	CD4093	510004093
U7	16DIP-P	B		CMOS	RCA	CD4532	510004532
U8	16DIP-P	B		CMOS	RCA	CD4008	510004008
U9	16DIP-P	B		CMOS	RCA	CD4042	510004042
U10	16DILP				RCA	CA3081	500030810
U11	16DIP-P	B		CMOS	MOTOROLA	MC14511	510004511
U12-13	14DIP-P	B		CMOS	RCA	CD4093	510004093
U14-15	16DIP-P	B		CMOS	MOTOROLA	MC14511	510004511
U16-17	16DIP-P	B		CMOS	RCA	CD4042	510004042
U18	16DILP				RCA	CA3081	500030810
U19	14DIP-P	B/UB		CMOS	RCA	CD4011	510004011
U20	14DIP-P	B		CMOS	RCA	CD4013	510004013
U21	16DIP-P	B		CMOS	RCA	CD4049	510004049
U22	16DILP				RCA	CA3081	500030810
U23	14DIP-P	B		CMOS	RCA	CD4013	510004013
U24	16DIP-P	B		CMOS	RCA	CD4049	510004049
U25	14DIP-P	B		CMOS	RCA	CD4013	510004013
U26	16DIP-P	B		CMOS	RCA	CD4017	510004017
U27-28	14DIP-P	B/UB		CMOS	RCA	CD4011	510004011
U29	16DIP-P	B		CMOS	RCA	CD4020	510004020
U30	16DIP-P	B		CMOS	RCA	CD4060	510004060
U31	14DIP-P	B/UB		CMOS	RCA	CD4012	510004012
U32	14DIP-P	B/UB		CMOS	RCA	CD4001	510004001

Table 8—5. Power Supply Module (A4) Parts List

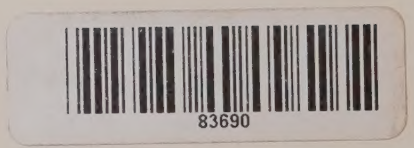
REFERENCE DESIGNATOR	DESCRIPTION VALUE	POWER	TOL	VOLTS	MFGR.	MFGR. PART NO.	N.E.C. PART NO.
A4A1	ASSY 96790 PWR SUPPLY PC						A4100100013
F1-2	FUSE 3AG				LITTELFUSE	3AG	863100200
J1-2	MT332B				SWCRFT	5J-1583	650403100
J3	3-PIN	6A		250V	BELDEN	17252	652201700
J4	BINDING POST METAL GND				H H SMITH	137SP	652500100
S1	DPDT LOCKING				SWCRFT	4620ELF	645500200
T1	PRI 115/230,SEC 2-20,1-12				PROFILE	2020	420100101
U1-2	TO-3			12V	FAIRCHILD	7812KC	500078120
XF1-2	FUSEHOLDER,3AG PANEL				BUSSMAN	HKP	863000100

Table 8—6. Power Supply PC Board 96790 (A4A1) Parts List

REFERENCE DESIGNATOR	DESCRIPTION VALUE	POWER	TOL	VOLTS	MFGR.	MFGR. PART NO.	N.E.C. PART NO.
C1-2	1100UF			30V	SPRAGUE	39D118G030GP4	300001180
C3	250UF			50V	SPRAGUE	39D257G050HE4	300002570
C4-6	22UF		10%	15V	KEMET	T330C226K015AS	310002261
CR1-15	D041	1A	SI	800V	EDAL	1N4006	560040060
F3	FUSE 3AG				LITTELFUSE	3AG	863100300
K1	4C			48V	MIDTEX	156-24D100	604106100
R1	10-	1/4W	10%		AB	TYPE CB	200101006
R2	68-	3W	5%		W LEONARD	TYPE 3X	210306805
VR1	A140	1W	1%	5.1V	SCHAUER	SZ5.1	562000510

Table 8—7. Mother Board 96791 (A5) Parts List

REFERENCE DESIGNATOR	DESCRIPTION VALUE	POWER	TOL	VOLTS	MFGR.	MFGR. PART NO.	N.E.C. PART NO.
S1	SPST				C+K	8125D9C	635201303
S2	SPDT				C&K	7101P4D9CQ	620400102
U1-3	14PDIL	20MA		RED	HP	5082-7650	728301701
XA1-7	TYPE 1F	22		DUAL MIL BLWS	AMPHENOL	225-22221-110	651701200
XU1-3	14PDIL				ROB NUGENT	ICL-143-S6-G	820100300



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